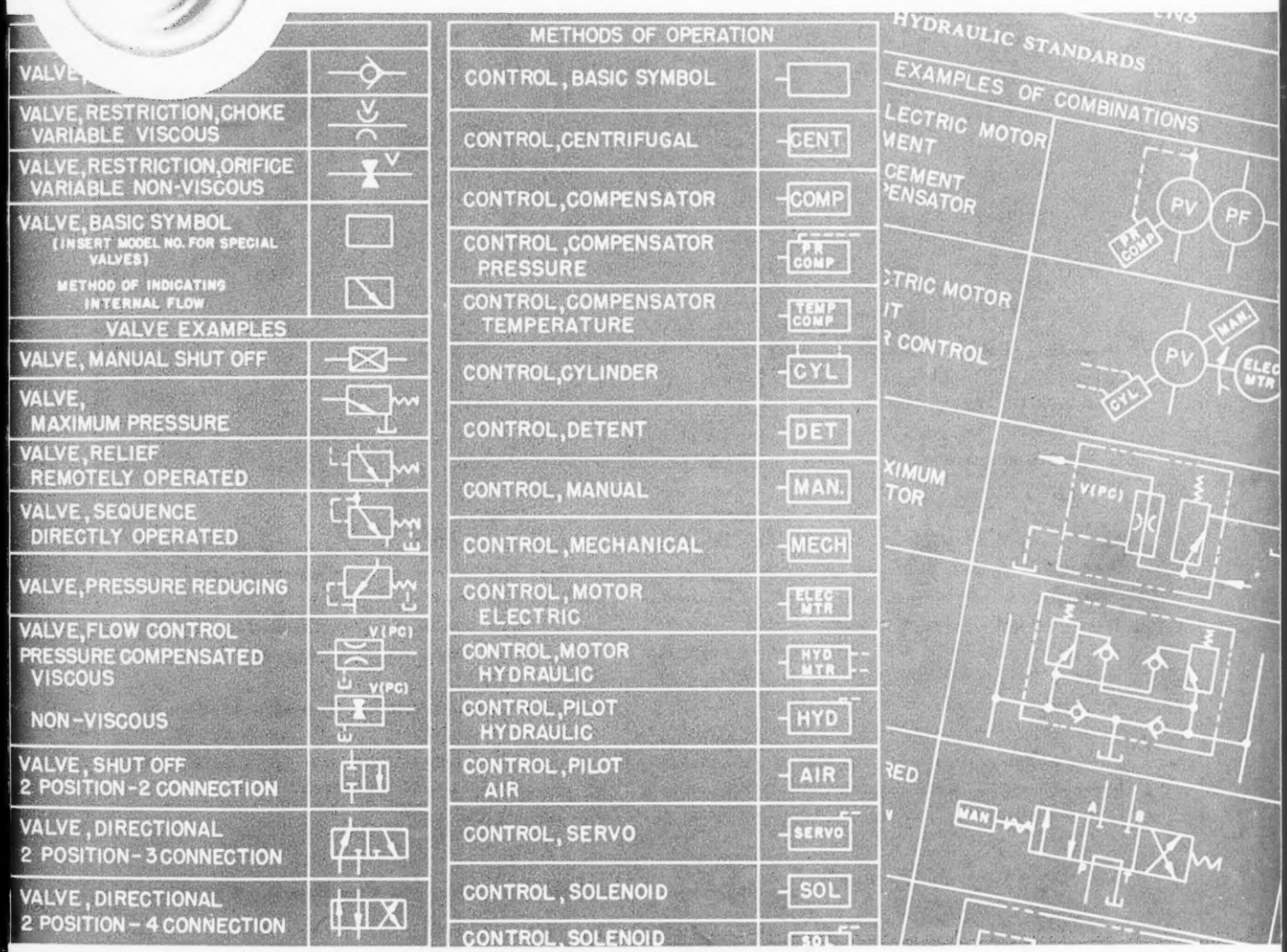
In this issue: CLEANING LUBRICATION SYSTEMS

FEBRUARY, 1953

Vol. 9, No. 1

Lubrication ENGINEERING



JIC HYDRAULIC STANDARD SYMBOLS

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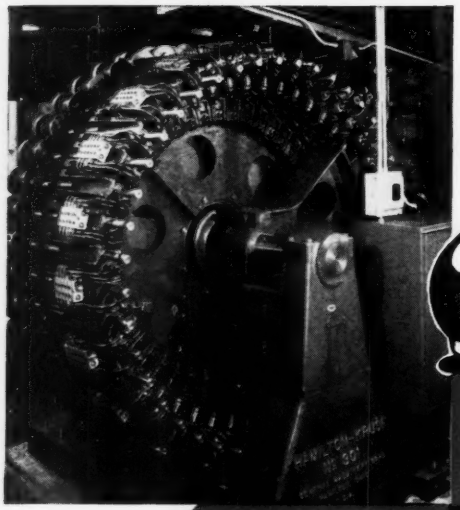

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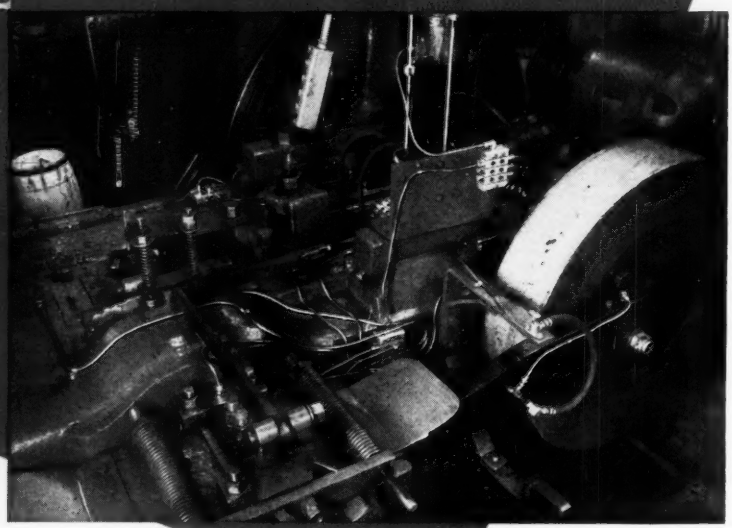

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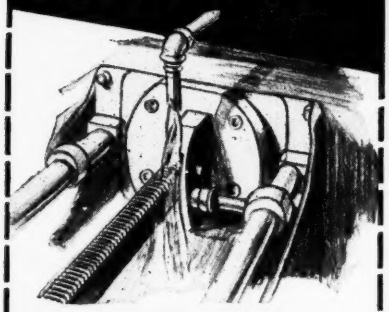

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Lubrication ENGINEERING

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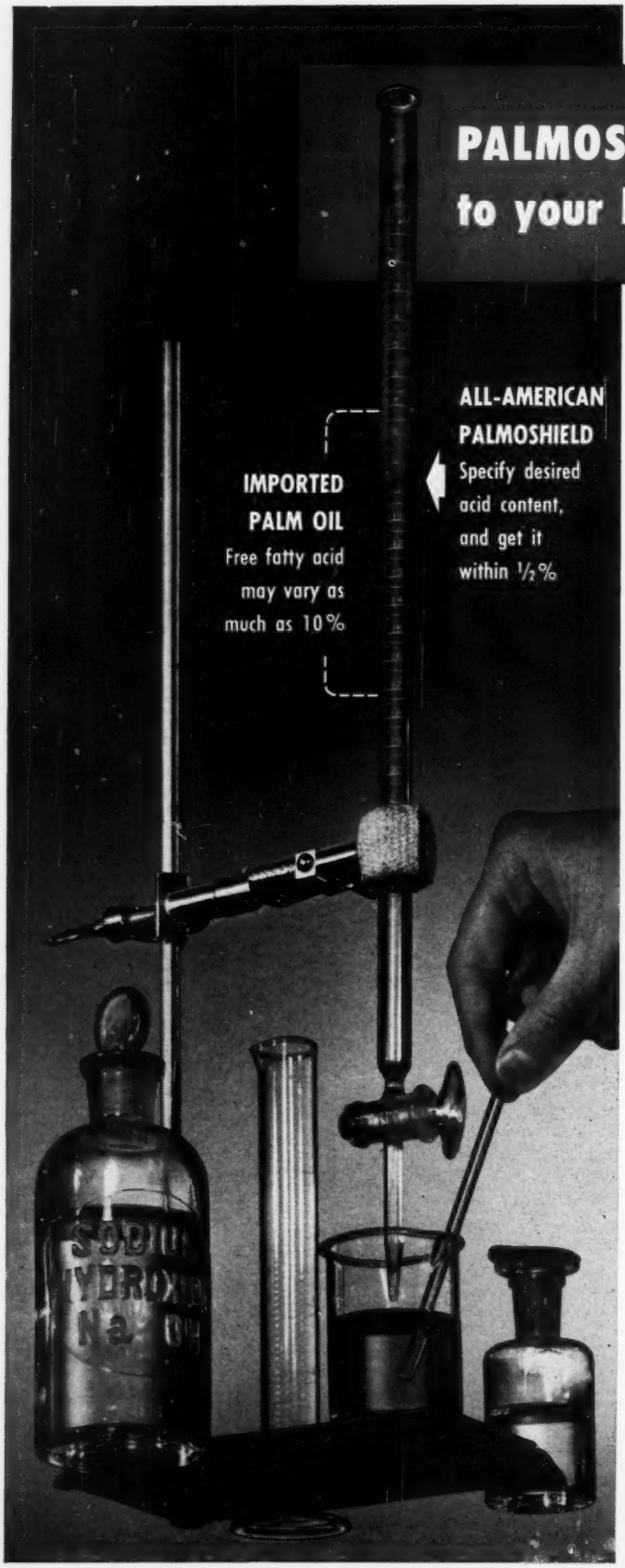

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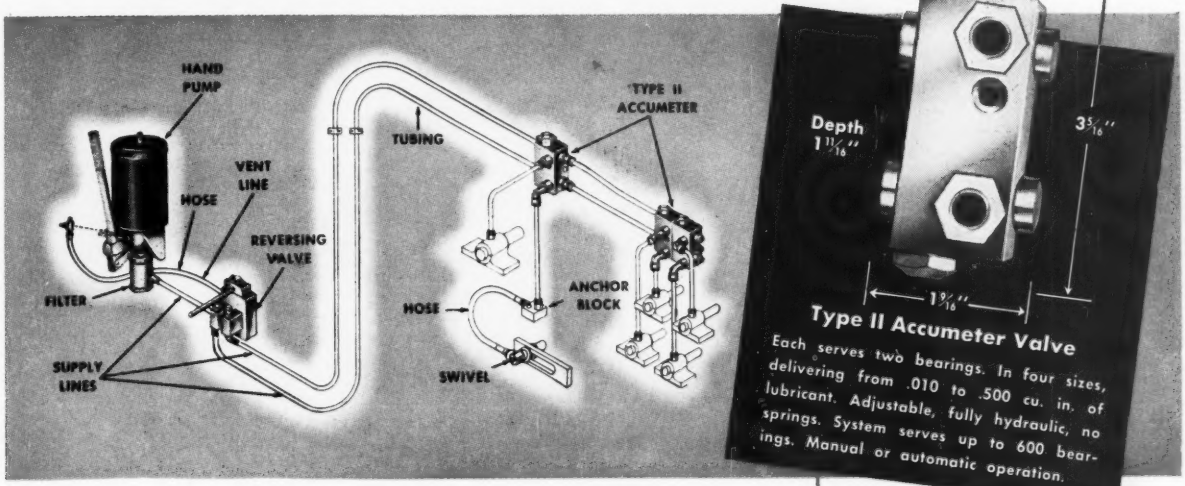

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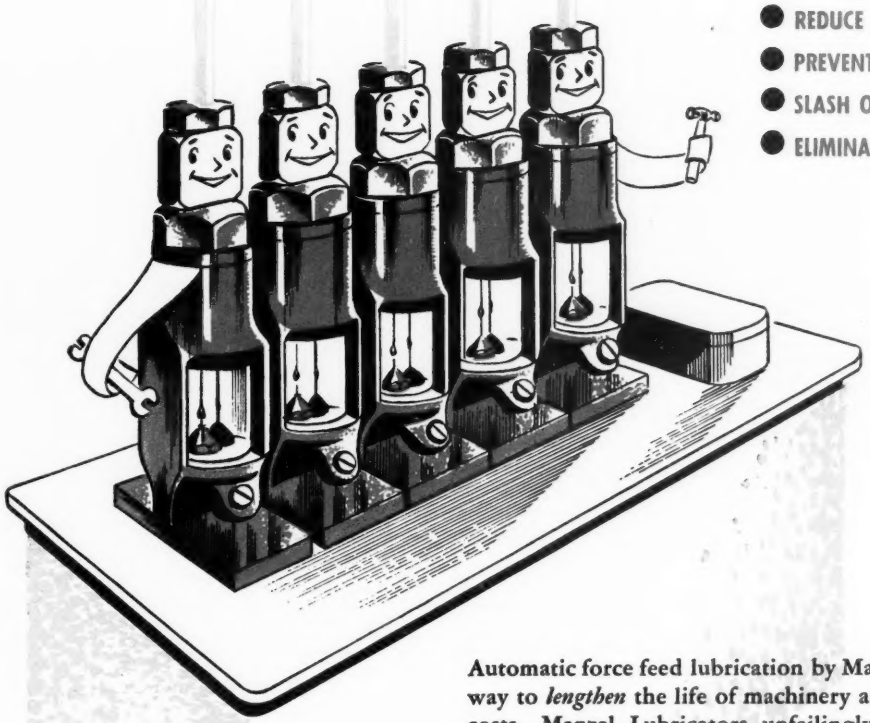

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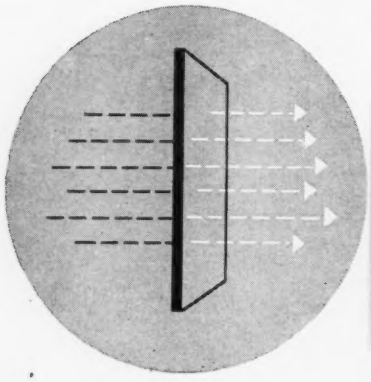

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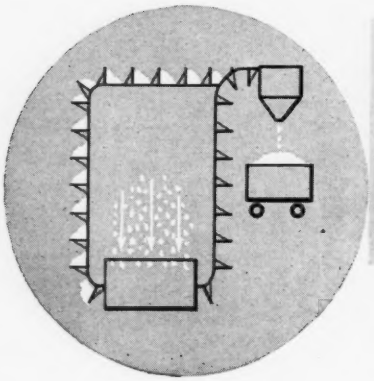

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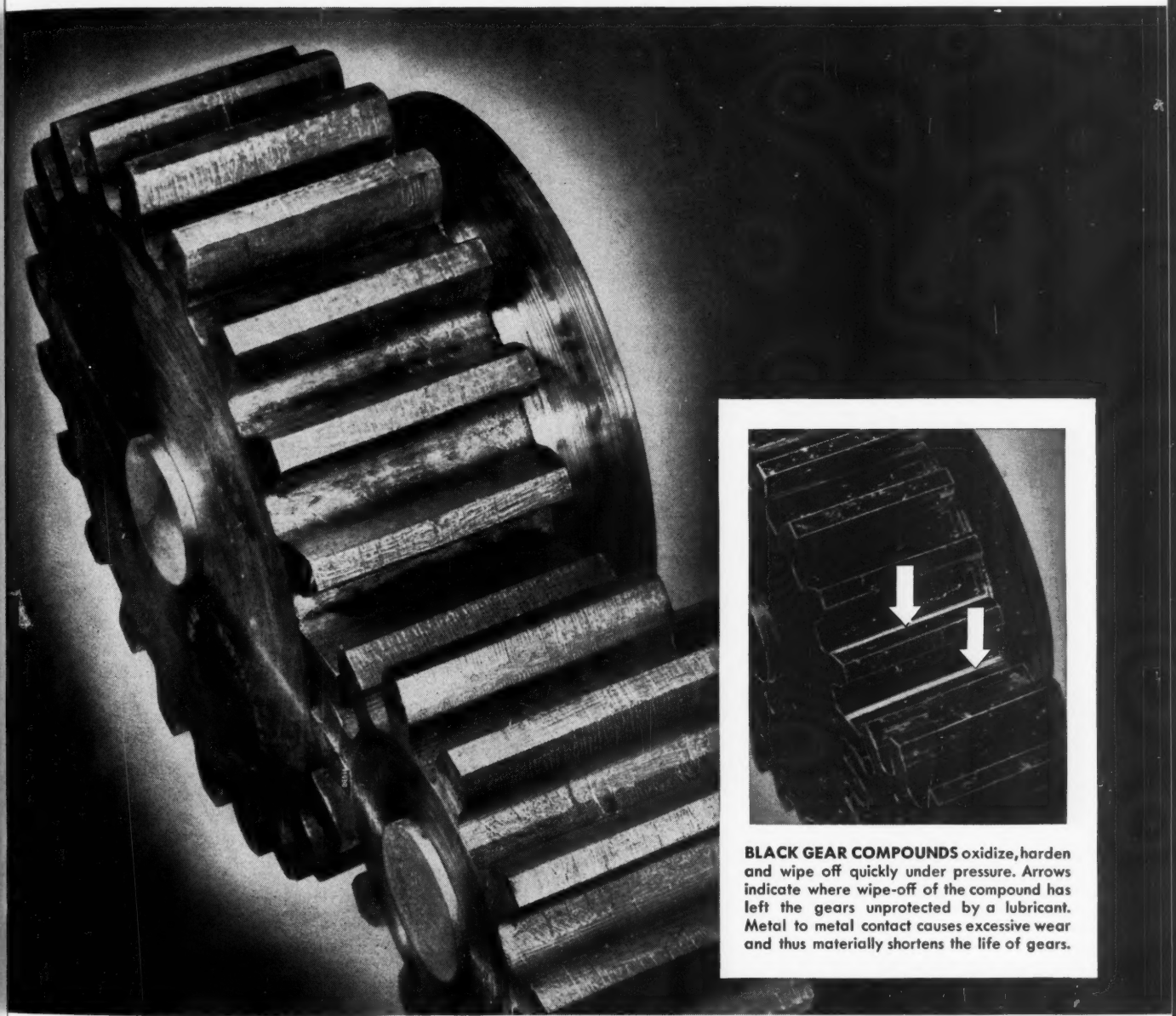

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NO SQUEEZE-OUT due to pressure. A thin, transparent film of Sun 897 Adhesive Pressure Grease stays evenly distributed on the gears and gives positive lubrication at all times. Sun 897 is water resistant and can be easily applied with a brush.

ANNUAL MEETING HI-LITES

1953 ASLE ANNUAL MEETING AND EXHIBIT
HOTEL STATLER, BOSTON, APRIL 13-14-15

A partial list of papers to be presented at the 8th ASLE Annual Meeting & Exhibit include:

- Air Bearing Studies At Normal & Elevated Temperatures, by J. D. Pigott & E. F. Macks
- Anti-Friction Bearings Symposium: Bearing Troubles On Ball & Straight Roller Bearings
- Anti-Friction Bearings Symposium: Diagnosing Bearing Troubles By Audio Means
- Boundary Lubricating Characteristics Of Synthetic Oils At High Sliding Velocities, by E. E. Bisson
- Design & Service Requirements Dictate Characters Of Oil Additives, by G. R. Furman & E. C. Knowles
- Development Of Significant Bench Tests For Aircraft Turbine Oils, by E. A. Ryder
- Effect Of Lubricant Viscosity On The Cooling & Lubrication Of Cylindrical Roller Bearings At High Speeds, by W. J. Anderson & E. F. Macks
- Friction & Boundary Lubrication, by A. C. West
- Lubrication In Design & Operation Of Textile Machinery, by R. M. Jones
- Method Of Evaluating Cutting Oils On A Lathe By Means Of A Tool Blade Wear Test, A, by L. C. Hays & E. J. R. Hudec
- New Theory Of Metal Transfer & Wear, A, by I-Ming Feng
- Significance Of Laboratory Test Data On Greases, by A. E. Baker & E. R. Booser
- Significance Of Laboratory Test Data With Respect To Used Lubricants, by C. L. Pope
- Sleeve Bearings Symposium: Electrographic Spot Testing Of Bearing Surfaces, by A. O. DeHart & A. E. Roach
- Sleeve Bearings Symposium: Engine Bearings, by E. Crankshaw
- Solid Lubricants, by W. E. Campbell
- Some Viscosity-Shear Characteristics Of Lubricants by E. E. Klaus & M. R. Fenske
- Test Data Symposium: Properties Of Lubricants Of Significance To Textile Industry, by K. P. Powers
- Viscosity Studies Of Fluid Lubricants At High Pressures, by L. B. Sargent

R. H. Josephson, Program Chairman

Lube Lines

PROGRESS REPORT: JIC HYDRAULIC STANDARDS (in this issue): The last several years have seen rapid development in automatic and semi-automatic machine tools and other industrial equipment. Some of the most notable have been: "In-line Machines" for multiple operations on a single part; "Automation" for automatic loading and unloading of machinery; and the increased use of conveyor systems. These developments were primarily the result of attempts to obtain maximum manhour productivity. However, development of ideas concerning accessibilty to components, protection from contaminates, and adequate safety for the operator, did not keep in step with the increased complexity of such machinery.

These conditions, if allowed to continue could have jeopardized the whole idea of transferring as much as possible the burden of production from the man to the machine. In recognition of this, a group of automobile manufacturers and other interested associations and equipment builders, developed what is now known as JIC (Joint Industry Conference) Standards.

The JIC Standards are quite different from most standards in that there are few dimensional limitations and could be described as merely a collection of good engineering and installation practices. This type of standard is good in that it allows the machinery builder to use the full scope of his ingenuity in the solution of production problems while at the same time helps him build machinery that is safe, easily maintained and with a lower breakdown potential. The JIC Standards presently published cover the following subjects: Hydraulic, Electrical and Pneumatic. (The Ford Motor Co. has published Lubrication Standards for Industrial Equipment, similar in pattern to the JIC Standards.)

The three papers in this issue under the general title PROGRESS REPORT: JIC HYDRAULIC STANDARDS are a critical analysis of the progress of the standards by acknowledged leaders in the art of hydraulic application. The progress of the standards you will note is looked at from the view point of the Hydraulic Equipment Builder (Mr. J. Robinson), Machine Tool Builder (Mr. K. Tech), and the User (Mr. A. McHugh).

JIC Standards may be obtained by writing: Joint Industry Conference, Box 182, North End Station, Detroit 2, Mich.

D. P. Morrell, Ford Motor Co.

TRAINING FILM: A straight documentary 16 mm sound film entitled Basic Principles of Lubrication has been produced in England by Esso, with technical service handled by Dr. F. P. Bowden and Dr. D. Tabor of the Department of Physical Chemistry at Cambridge University. Taking about an hour of viewing time, the film describes in a simple manner the basic principles of lubrication with laboratory proofs of these fundamentals. There is one copy available in the United States which may be had by writing: Esso Training Center, Attn. A. E. Daraghy, 1104 Elizabeth Ave., Elizabeth 4, N. J.

INDUSTRIAL LUBRICATING CONFERENCE HILITES: Seventy-eight persons attended the Industrial Lubrication Conference sponsored by the ASLE Kingsport Section and conducted by the College of Engineering, University of Tennessee, on December 5, 1952 (Group Picture above). C. E. Brehm, President of the University of Tennessee, presented the welcoming address, with L. G. Haller, Tennessee Eastman Co., acting as Chairman. Speakers and their papers included: C. T. Stone, Esso Standard Oil Co., Lubrication—Your Job and Mine (See Lubrication Summarized); C. L. Pope, Eastman Kodak Co., Mechanics of Lubrication (See Lubrication Summarized); T. R. Witt, Tennessee Eastman Co., Planned Lubrication as a Part of Plant Maintenance (See LUBRICATION ENGINEERING, Dec., 1952); M. E. Merchant, The Cincinnati Milling Machine Co., ASLE President, ASLE—A Service Organization; and W. P. Youngclaus, Jr., ASLE Administrative Secretary, Lubrication Engineering Comes of Age.

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JET PROPULSION FELLOWSHIPS: Daniel & Florence Guggenheim Jet Propulsion Fellowships are to be awarded for graduate study at Princeton University and the California Institute of Technology, at the Jet Propulsion Centers established in 1948 for the purpose of selecting and training outstanding men for basic research and for leadership in the development of rockets and jet propulsion, with particular emphasis on peacetime uses. A total of $18,000 in stipends is available at each institution with fellowships carrying a stipend ranging from $1,000 to $2,000 annually, plus tuition, for study toward advanced degrees. The Fellowships are open to qualified college graduates with suitable engineering or scientific undergraduate preparation; candidates must have outstanding technical ability, demonstrated leadership

(Continued on page 43)

CLEANING LUBRICATION SYSTEMS*

by A. S. Morrow
Shell Oil Co.
50 W. 50th St.
New York, N. Y.

After receiving his BS degree in Chemical Engineering from Lehigh University, Mr. Morrow was employed by Socony-Vacuum Oil Co. as Refinery Engineer in charge of the Houdry Catalytic cracking unit, the first installation of this type in the United States. He served in the U. S. Navy as Petroleum Engineer at various continental naval activities and toured the Pacific areas as trouble-shooter on fuel and lubricant problems encountered by the fleet. As a Staff Engineer, Lubricants Dept., Shell Oil Co., he is responsible for the development, application and performance of lubricants used in turbines, hydraulic systems, transformers, refrigerators, and allied equipment that require inhibited products. Within the scope of this work, considerable time is given to the cleaning and preparation of systems to receive new oil and the maintenance of oil in service.

ABSTRACT: One of the worst enemies of lubricants is contamination. Many equipment failures are due to dirty systems to which clean lubricant is charged. This paper discusses the importance of cleaning and methods of carrying it out for turbines, hydraulic systems and various types of other machinery. It is suggested that technical lubrication discussions should give more consideration to this subject in the future, since it is of vital interest to plant maintenance engineers.

The cleaning of new and in-service lubrication systems, particularly turbine and hydraulic units, has been the subject of extensive investigation and discussion by various interested groups for many years. However, very little has been published concerning the cleaning of other types of machinery. As a result, flushing procedures utilizing a petroleum solvent that have been devised are divided into two groups, those for flushing new systems and those for flushing systems that have been in service for extended periods. Additionally, materials are commercially available for direct addition to dirty systems for removal of deterioration products by either solutizing or chemically reacting with the contaminant. The ultimate object in all cases is the removal of contaminants that exert an adverse effect on the proper and continuing function of the fluid or lubrication present in a particular system.

In new systems, contamination can be caused by various factors such as core sand, dirt, dust, metallic particles, rust, rust-preventive compounds, chemicals, compounded oils, etc. Depending on the application, in-service systems may contain dirt, dust, moisture, deteriorated oils, process oils, products of combustion, industrial gases and, in fact, most anything imaginable. Therefore, the basic problem is the obtaining of a clean system to allow the fluid or lubricant to provide the service for which it was intended.

Past experience has shown that the greatest percentage of field complaints relative to the malfunctioning of a product arise not from deterioration of the product, but by various types of contamination. For example, inhibited oil charged to a new unit can be affected by certain rust preventives used for preservation of systems during shipment in the following manner:

	ASTM D943-47T (TOST)
New Oil	1,000 + hrs.
New Oil + 1% Rust Preventive	550
New Oil + 3% Rust Preventive	440

	FSB 320.13 EMULSION TEST @ 130 F.
New Oil — Distilled H_2O	18 minutes — clear
New Oil — Synthetic Sea Water	12 minutes — clear
New Oil + Trace Rust Preventive Distilled H_2O	58 minutes — cloudy
New Oil + Trace Rust Preventive Synthetic Sea Water	47 minutes — cloudy

Inhibited oils charged to systems containing deterioration products can have their expected life drastically reduced, i.e.:

	DORNTE OXIDATION 650 CC OXYGEN ABSORBED @ 120 C.
New Oil	150 hrs.
New Oil + 0.5% Oxidized Oil (Acid No. 0.49)	80 hrs.
New Oil + 1% Oxidized Oil (Acid No. 0.49)	55 hrs.
New Oil + 2% Oxidized Oil (Acid No. 0.49)	45 hrs.

Within normal ranges of temperature and pressure many oils would provide much greater service than is realized if proper conditioning of the systems before and after charging of the oil would have been carried out. Actually, cleaning a system is sound oil maintenance practice since it will save industry many dollars by reducing breakdowns, loss of production, replacement part costs and labor.

*Presented at the ASLE New York Section Meeting, May 6, 1952.

Generally, materials employed for cleaning are: (1) Flushing oils. (2) Solvents (petroleum, halogenated, etc.). (3) Chemical compounds (acids, alkalis). (4) Water or steam washing.

Flushing oils are basically lubricants but may contain certain additives and inhibitors to provide maximum cleaning action. The viscosity and solvency of the base stocks used in these oils will vary over a considerable range, depending upon the application. For instance the viscosity will be as low at 40 SSU @ 100 F. or as high as 1000 SSU @ 100 F. while the aromaticity may be nil, or be quite high, again depending on the selection of stocks, or it may be improved by the addition of pure aromatics. In the main, the flushing oils are low viscosity index, naphthenic type products, since they have good solvency for deteriorated oil, gummy deposits, and their contaminants. However, high viscosity index paraffinic type flushing oils are used where the contaminants present are easily removed by warm oil. Inhibitors and additives are also blended in flushing oils to provide desired characteristics. The additives and inhibitors are usually compatible with the operating charge and, therefore, any residual flushing oil has little or no effect on the performance of the new oil. Oxidation inhibitors, for instance, will improve the stability of the residual oil, while, rust inhibitors will protect the freshly cleaned surfaces until the final charge is installed. Additives for picking up moisture are also advantageous in that wet sludges and emulsions can be broken and thus removed. Detergents and dispersants are also used to assist in peptizing carbonaceous deposits and holding them in suspension until removed by the flushing oil. In the main, the type of flushing oil selected will depend on the condition of the system to be cleaned.

In the majority of cases flushing oils have a distinct advantage over other types of media, i.e.: (1) System can be cleaned without extensive dismantling of the piping. (2) Operation of the equipment permits cleaning of all parts bathed by the oil. (3) Cleaned surfaces are protected by the oil. (4) Minimum hazard to personnel. (5) Small percentages of flushing oil do not adversely affect operating charge. (6) Cost is moderate.

In comparison, solvents (petroleum and non-petroleum types), although they may more effectively remove hard tenacious gums and lacquers, have certain shortcomings among which are: (1) Tendency to disperse contaminants throughout a system permitting precipitation in areas of reduced flow. (2) Small quantities effect the stability of the system oil. (3) Toxicity and vaporization at fairly low temperatures. (4) Fire hazard. (5) Lack of lubricity prevents operation of the equipment. (6) Generally permits accelerated rusting of the newly cleaned surfaces.

Many field complaints are found to be caused by the foregoing, not because the solvent did not remove the contaminant, but because of other factors. Among them are reduced viscosity, shortened oil life, increased acidity and rusting. The solvents also tend to soften and strip paints, which creates an additional operating problem.

Chemical compounds, such as alkalis or acids, likewise do an excellent job of cleaning dirty surfaces, but precaution must be taken that all traces of the compound are removed before the part is contacted by the oil. Petroleum lubricant performance can be adversely affected by these materials through emulsification, foaming, and reduced stability. Rusting is also possible, unless the part is immediately protected after cleaning.

Steam and/or water washing should not be practiced in assembled systems. With the intricate piping arrangements in use, it is evident that all traces of moisture cannot be removed. Consequently, by using this method the oil may become emulsified, water may be pumped to inaccessible regions, and rusting might occur. If piping or lines are taken down, and steamed/or water washed, they should be blown clear with warm dry air, wiped with lintless rags and coated with oil.

Since the types of procedures vary considerably, an attempt will be made to discuss cleaning techniques based on field experience of the equipment involved. It should be pointed out that before any method is agreed upon, a careful inspection of the system should be made by the interested personnel to determine the extent of contamination. Based on this inspection, the type of cleaner, procedure and time involved can be tentatively decided on and the cleaning can then proceed.

STEAM TURBINES: Cleaning and flushing of steam turbines have been practiced for many years. Procedures are available in the literature of which the most recent is the Recommended Practices for the Cleaning of Turbine Lubricating Systems prepared by the Joint ASTM-ASME Committee on Turbine Lubrication. These procedures cover the cleaning of new systems, cleaning after service and the purification of turbine oils.

With respect to new systems where rust preventives are not a factor, there is a definite trend to the use of a regular turbine oil of the required viscosity as a flushing oil. This is generally true for the larger units wherein the piping is shipped separately and hand cleaned before hanging in place. Smaller units shipped with the plumbing installed may have had rust preventives sprayed through the lines which require considerable cleaning before operation. In this case a flushing oil with good solvency, water displacement ability and rust inhibition should be used, for it has been found that certain rust preventives tend to age during storage, thereby lowering their solubility in even hot turbine oil. A case in point has been the experience wherein it required four charges of turbine oil before eliminating an emulsification problem in a "packaged unit." This was caused by the polymerization of a rust preventive which the manufacturer had stated was soluble in warm oil. Consequently, the cleaning was both time-consuming and costly. Oil/water resisting paints have also created certain problems when flushing turbines. There are a number of paints available which are not affected by oil and water within normal temperature ranges, provided they have been properly applied. However, if the metallic surface had not been thoroughly cleaned and the paint carefully worked in, warm turbine oil will tend to blister and raise the paint. Flushing oils under these conditions have been found to actually strip the paint, causing considerable delay in the procedure. This possibility of paint attack during flushing of new units has been one of the underlying reasons for the trend to the use of turbine oil in preference to regular flushing oils.

Thus even though a unit is new, a thorough inspection and investigation of the condition of the system should be carried out before reaching a decision on the type of oil to be used for flushing and what procedure should be followed.

Systems that have been in service and are contaminated with degradation products are normally cleaned with a flushing oil. Old systems that have been operated with conventional oils and are being changed to inhibited oils should be cleaned in the same manner. The necessity for cleaning is quite obvious, as it is always desired to obtain the maximum benefits from the new charge of oil.

The activation of laid-up marine vessels pointed up the preceding remarks quite forcibly. At the time of preservation, main propulsion units were coated with a rust preventive compound stated to be soluble in hot turbine oil (150 to 160 F.). However, when this procedure was attempted, the preventive could not be removed with turbine oil when heated to 200 F.

In addition, the systems in some cases contained rust or were contaminated with various materials. On investigation it was determined that the preventive tended to polymerize during long-term storage rendering it insoluble in the hot turbine oil. The development of a turbine flushing oil followed, which had excellent solvency for the aged preventive, was able to take water into solution and, furthermore, had rust-inhibition qualities. This oil in small quantities, 1 to 3%, had no effect on the operating oil charge, which is of importance in flushing any system as the additives and inhibitors employed must be compatible with those in turbine oil. The flushing charge is usually displaced with turbine oil of the same viscosity as the operating charge to wash out any contaminants that may have been loosened but not removed by the flushing oil.

In most cases the oil used for flushing, if not badly contaminated, can be used for cleaning subsequent units. Regular turbine oil, for example, has been used for cleaning two or three units, and after adequate filtration and laboratory analysis, retained for use as turbine make-up oil or lubrication of auxiliary equipment. Flushing oils, on the other hand, are applicable only to cleaning and, although used in a number of units, they cannot be used for lubrication under any circumstances. In some cases the oil has been pumped to fuel bunkers and burned under the boilers, thereby realizing a small saving. However, the overall economic advantages gained from a flushing oil far overshadow the initial cost.

HYDRAULIC SYSTEMS—MACHINE TOOLS: The preparation of new systems for a charge of oil is one of careful inspection. As the greatest number of hydraulic systems are of small capacity, 20 to 100 gallons, and integral with the machine, the manufacturers will ship the unit completely sealed against the ingress of any contaminants, which theoretically precludes the necessity of extensive cleaning prior to start-up. However, the unit and particularly the sump may have been coated with a rust preventive which requires removal. In these cases flushing with either a recommended flushing oil or a hydraulic oil is in order until all traces of the preventive have been removed. Some units have sumps coated with oil/water resistant paints so that caution must be exercised in selecting a flushing media. In any event, removal of any contaminant must be carried out to provide good operation.

Units in service, if the oiling system has not been properly maintained, tend to build up gums, lacquers, and sludges, particularly in the closely fitted areas such as the valves, spools and pumps. This naturally causes erratic operation and possibly stoppage of the machines. When this condition arises, many operators will add 5 to 10% of an active solvent to the hydraulic oils in the hopes of overcoming the problem. Depending on the type and degree of contamination results are very often spotty, but in any event the relief is only temporary for the basic cause of failure had not been eliminated. Actually, it has been indicated that troubles may be increased for two reasons. One, the solvents may be unstable under operating temperatures, tending to accelerate oil deterioration, and, second, the solvent will remove degradation products from one area, circulate them through the system and permit precipitation in other areas. Additionally, certain solvents are low-boiling, low-flash, toxic and extremely active materials which result in hazardous operating conditions.

The more logical approach under the aforementioned problem would be the complete removal of the hydraulic fluid, manually cleaning all accessible areas and charging with a petroleum flushing oil. Products are available from major suppliers that permit short-term operation of the unit and which will remove a large percentage of the contaminants. Auxiliary filtration should be employed, if possible, for removal of solids, while heating of the oil will materially assist and expedite the procedure.

It has been found that many oils in service, aside from contamination with water, metalworking fluids, table-way lubricants, etc., have been affected by solvents. Analyses of oils from two well-known grinders, for instance were:

	1	2	NEW OIL
Gravity, API	30.1	29.9	30.3
Color, ASTM	2½	4	1+
Flash, COC, °F.	Foamed	410	400
Water, % vol.	1.9	None	None
Viscosity, SSU @ 100	165	172	158
TAN-C	0.09	0.20	L.T. 0.05
Saponification No.	1.0	1.1	0.2
Chlorine, % wt.	1.4	0.6	None
Sludge, % Insol. in			
Pentane	0.04	0.05	None
Benzene	0.03	0.03	None

Note was taken of the variance in the results when compared with the new oil, and aside from the water in sample No. 1, it was indicated that both oils were contaminated with a chlorinated product. Investigation and discussion with the operators elicited the information that not only were the systems flushed with a chlorinated solvent, but another similar product was added directly to the oil from time to time. It was agreed that solvents would not be used, except under exceptional conditions. Since then, which is approximately eight months, no complaints have been received.

STEEL MILLS: As hot and cold strip mill backup roll bearings are lubricated generally by pressure circulation systems, cleaning can be accomplished through flushing oils to remove any contamination.

New units have been cleaned by mineral oils having viscosities from 100 SSU @ 100 F. to 100

SSU @ 210 F., while contamination of in-service systems has been removed through the use of special flushing oils. The procedure in both cases is relatively simple, requiring only sufficient oil to maintain pump suction in the clean oil tank. Steam coils normally installed in the tanks or low-pressure steam piped to the oil cooler can be used to heat the oil. Auxiliary filtration should be provided to assist the installed purification devices in removing the contaminants. Circulation is maintained until inspection indicates cleaned surfaces. Other bearings, such as the grease-lubricated work rolls, will require disassembly and hand cleaning. Drive gears and other auxiliary equipment that are lubricated by pressure circulation can be flushed similarly to the back-up rolls.

PAPER MILLS: Many of the modern paper machines have a combination settling and filtration tank which acts as an oil reservoir for lubrication of the dryer end. The design permits by-passing of one of the tanks, thereby reducing the volume of flushing oil needed for circulation. Procedures again are very similar to those used for any large system, i.e., steam turbines and steel mills. Flushing oils also are similar. If the system is new, but contains rust preventives, compounded oils, etc., a special flushing oil should be used, but if the system has been hand cleaned conventional mineral oil is satisfactory. However, in-service systems may contain sludges formed from degradation products, paper dust and water and should, therefore, be cleaned with special flushing oils. Heating of the oil to 160 to 170 F. is an absolute must, and sufficient time must be allowed to assure complete removal of all contamination. A displacement charge is recommended to remove the flushing oil and heavy sludges that may deposit in low spots or traps. The viscosity should be either intermediate between that of the flushing oil and the operating charge, or be the same viscosity and type as the latter.

Various gears may also be lubricated by the bearing system oil. Inspection covers of the gear cases should be removed and a thorough inspection made. If necessary, hand cleaning should be resorted to for removal of all contaminants.

Since the wet end of the paper machine is grease-lubricated, hand cleaning the bearings is recommended.

COMPRESSORS: The successful operation of any compressor is greatly dependent upon the cleanliness of the gas to the compression end. Those units with gas scrubbers or air filters will give extended service, while those without may become fouled in a relatively short time. However, since the valves and cylinders are lubricated by oil which is carried in the gas stream, it is difficult to satisfactorily use a flushing oil. Whenever necessary, hand cleaning of the valves and cylinders should be carried out using various type of materials. One method requires a steam vat and a caustic agent. The valves are placed in the vat, "cooked" for a short period, water washed, blown dry, and then dipped in oil. Another method requires a special solvent in which the part is soaked. It is then scrubbed, washed off and dried. As both of the materials are very active agents, it is necessary to exercise proper precautions in handling; provide protective clothing for the personnel and adequate ventilation.

The crankcase, on the other hand, can be cleaned very nicely by circulating a flushing oil and using an auxiliary filter.

INTERNAL COMBUSTION ENGINES: With the advent of detergent-dispersant oils, the need for flushing oils for cleaning dirty engines is being gradually reduced. It appears that sludges formerly developed from straight mineral oils are no longer a real problem as the detergency of the HD type of oils carries the deterioration products in suspension, preventing their deposition and thereby the formation of sludge.

New engines may be flushed out with a special break-in oil, but normally the same type of oil is used as that recommended for operation. Oil change periods may be shortened for the initial run-in, but subsequent use of HD oil precludes the need for flushing.

HEAT EXCHANGE SYSTEMS: Oils used as a head transfer media in enclosed systems are not subject appreciably to oxidation but are affected by cracking and possibly polymerization, the result being the deposition of extremely tenacious films on the tubes that resist removal by regular flushing oils. Cleaning by steam or hot water is not entirely effective nor is disassembly and hand cleaning always possible. Materials containing detergents, wetting agents and resin solvents in a petroleum carrier have been employed very successfully. Although the flash point of the product is not too high (160-180 F.), it has been safely heated to within 20 F. of this range to accelerate the action. Since the product will emulsify, hot water is subsequently circulated to remove traces of contaminants in the old oil and the solvent.

GENERAL CLEANING: Small oil-lubricated units can be cleaned by the use of portable rigs having a storage tank, pump and filter, or they can be cleaned fairly well by placing the oil in the reservoir, turning over the equipment for a short period, draining and filling with new oil. Inspection should be done wherever possible.

Grease-lubricated bearings can be cleaned with a low-boiling solvent, drying and dipping in oil. High boiling solvents or halogenated materials are not recommended due to possibility of residual solvent affecting the grease or the formation of incipient rust during cleaning.

The cleaning of lubrication systems, with the exception of steam turbines and hydraulics, has not received the attention of technical societies that it merits. Most of the committee work of the societies has covered the design of the equipment, the development of satisfactory lubricants and approval of laboratory test methods. However, aside

(Continued on page 42)

REDUCTION OF GEAR FAILURES, by S. D. Craine, W. A. Jones Foundry & Machine Co., will be featured in the April issue of LUBRICATION ENGINEERING as the sixth in the series of Practical Lubrication articles. At the conclusion of this series, the Society will publish the papers in book form as another of its practical lubrication manuals.

RECOMMENDED PRACTICES FOR THE CLEANING OF TURBINE LUBRICATING SYSTEMS AFTER SERVICE*

by Joint ASTM-ASME Committee
on Turbine Lubrication
F. E. Rosenstiehl, Chairman

Mr. Rosenstiehl, Manager of the Lubrication Sales Division of the Texas Co., 135 E. 42nd St., New York 17, N. Y., studied at Pratt Institute and the Brooklyn Polytechnic Institute before entering the company in 1918 as a Chemist, subsequently holding various positions in the Technical and Research Division. In the 35 years he has been associated with the petroleum industry, he has closely followed testing and application of all types of petroleum products and has obtained patents covering the composition of lubricants. He is Chairman of the ASTM-ASME Technical Committee C, Section 1, under whose supervision this paper was prepared.

INTRODUCTION: It should be emphasized that the procedure for cleaning lubricating systems of turbines after service should be accomplished through the cooperative efforts of the turbine builder, the operator and the oil supplier. No phase of this work should be undertaken without a thorough understanding of the possible effects on subsequent operation of the unit, nor should it be entrusted to persons lacking in experience without adequate supervision.

WHY CLEANING MAY BE NECESSARY: Trouble-free operation of steam turbines depends to a large extent upon the cleanliness of the lubricating oil system. After use, there may accumulate in such systems deposits as a result of contamination by impurities such as dust, dirt, lint, pulverized coal, fly-ash, rust, welding beads, scale, water, emulsions, insoluble oil degradation products and combinations of these. In addition, there is always the possibility of other materials in the surrounding atmosphere getting into the oil system such as cement dust, chemicals, etc., as well as the possibility of other foreign materials such as rustproof or pipe thread compounds, gasket or lagging materials, or cutting oil being left in the system after repairs or changes are made. These foreign materials may cause clogging of the oil lines with resultant bearing damage or failures, fouling of governors, deposit on coolers, etc. In addition, they may cause foaming, emulsification of the oil with water and accelerate oil degradation. Blistering or flaking of permanent-type protective coatings in tanks may occur and the loosened material may clog the lubricating system. It should be emphasized that mere draining of the oil from the system may remove only a small portion of the deposits described above.

Adequate oil purification during circulation, through the use of oil purifying equipment of proper size and design, will go far to prevent build-up of insoluble foreign matter in the system.

*Contributed by the Petroleum Div. for presentation at the Annual Meeting, N.Y.C., Nov. 26 thru Dec. 1, 1950, of The American Society of Mechanical Engineers.

Periodic inspections of the lubricating system will indicate whether proper maintenance practices are being followed and should be supplemented by other inspections when serious variations in operating data are observed. The following recommended practices cover normal procedures for checking on the extent of accumulation of deposits and for removing them from the system.

WHEN CLEANING MAY BE NECESSARY: Turbine manufacturers usually recommend that within the first year of operation, a new turbine be taken down for complete general inspection. This offers an excellent opportunity for also inspecting the oil system for evidences of deposits, corrosion and abnormal wear.

When a turbine is placed in service, a close watch should be kept until operating conditions have stabilized. By this means, normal oil outlet and inlet temperatures to bearings, coolers and other parts can be established. It is common practice to keep as a part of the log the temperature differentials across bearings and coolers. When this temperature differential at the coolers departs from the established norm, deposits may be accumulating on either the oil or water side of the cooler. It is also common practice to take frequent samples of the oil for visual inspection for the presence of water, emulsions or suspended matter. Laboratory tests made upon periodic samples, will indicate whether any significant change in the oil is occurring which might lead to the accumulation of deposits. Frequent inspections of the oil sump drain, and of the oil purifying equipment will also help to indicate the rate of deposit accumulation.

Any unusual conditions noted (increase in rate of deposit removal by the oil purifying equipment, departure from normal oil pressure at any point in the system or oil purifying equipment, presence of water in the oil, change in temperature differential, change in oil tests), will be a warning that some abnormal condition is present in the turbine system. Through inspection, the source of the difficulty must be determined and any deposits which have accumulated must be removed. It is, of course, desirable to eliminate the causes as soon as possible, to hold formation of deposits to a minimum and possibly avoid necessity for extensive cleaning of the lubricating system.

CLEANING OF TURBINE SYSTEMS: Inspection of the turbine lubricating system may show deposits ranging from a viscous oil film to solids which completely choke oil passages. When an appreciable quantity of deposit is found in a tur-

bine system, it must be removed. The method of cleaning will depend, of course, on the amount and the nature of the insoluble material present. Laboratory examination of a representative sample of the deposit will assist in determining the best means of removal. It is obviously impractical to make any all-inclusive statement on what should be considered an appreciable amount of deposit; only experience will serve as a guide to the evaluation of conditions.

Final decision as to the means of removing the insoluble material should be reached only after consultation with all parties concerned, including the turbine manufacturer and oil supplier.

OIL COOLERS (STATIONARY AND MARINE): A marked change in the oil temperature differential across the cooler with no change in water flow or water temperature may indicate an excessive build-up of deposits on the oil or water side of the cooler, or of both. On larger units, twin coolers are usually installed so that one of them can be removed from service for cleaning without interruption of turbine operation. Where the cooler tube bundle can be removed from the system cleaning methods may be employed which would not be considered practical for the turbine lubricating system proper. Hot water or steam washing, or petroleum flushing oil are usually employed for cleaning the oil side of the coolers.

If other cleaning agents are employed, they should only be used with full appreciation of the following:

Regardless of the materials used, all traces of the cleaner should be thoroughly removed to prevent subsequent oil contamination. The cleaner employed should not attack the finish of the tubes, since such attack may lead to the formation of metallic soaps which can stabilize oil-water emulsions. In addition, cases have been reported where cleaners have activated cooler tube surfaces making them extremely effective catalysts for turbine oil oxidation. After cleaning, hydrostatic tests should be made on coolers to check for leaks.

OIL SYSTEMS OF STATIONARY UNITS: The following methods have been used with success for the cleaning of stationary units of varying sizes. The particular method selected will depend to a large extent upon laboratory examination of the deposit and cleaning materials, facilities and time available. Regardless of the method selected, when appreciable quantities of deposit are present and accessible, the bulk of the deposit should, of course, be removed manually.

STEAM AND HOT WATER CLEANING (STATIONARY UNITS): Tarry matter from oil-degradation products and oil-water emulsions can often be removed from turbine parts by steam or hot water washing. Individual cleaning of parts is desirable when using these methods. Care must be taken not to blow steam or hot water into bearings or governor mechanisms which are usually cleaned manually. Steam is preferable to hot water due to the possibility of scalding.

When using hot water, boiler feed water at a temperature above 180 F., is usually employed and is blown through the piping at high velocity. If the piping can be dismantled, this may be done to insure more thorough cleaning. Bearing pedestals and oil reservoirs are cleaned by directing a stream of hot water against the surface of the parts. Clean dry air should be used immediately after the hot water to dry the parts.

Steam at high velocity has been used with good success under a variety of conditions. A flexible steam hose is used with the end covered with a cap tapped for the insertion of a short nipple with an opening approximately ¼" in diameter. Pedestals, reservoirs and pipe are steamed out and dried with clean, dry compressed air.

Since steam or hot water washing will remove protective oily films from metal surfaces making them prone to rusting, the lubricating system should be protected as quickly as possible with a rust-inhibited turbine or flushing oil. Governor parts should be dipped in the rust-inhibited oil immediately after cleaning and the unit should be assembled and a rust-inhibited turbine or flushing oil circulated through it as soon as possible.

CLEANING WITH FLUSHING OIL (STATIONARY UNITS): The oiling system should be arranged so as to obtain maximum oil flow and velocity. The exact steps to be taken depend entirely on the turbine construction. In some instances, maximum flow is secured by removing the upper halves of the bearings and any external orifices, if used; or by rolling the lower halves of the bearings about the shaft sufficiently to uncover the oil supply passages. The bearing pedestal covers are then replaced to prevent unnecessary oil leakage. In other cases, maximum oil flow is easily obtained by removing the internal connection pieces between the oil supply line and each bearing. The connection pieces are within the bearings housings and are accessible by removing inspection opening covers placed there for that purpose.

A sufficient charge for flushing (50-75% normal oil charge) of rust inhibited turbine of flushing oil is then placed in the turbine. The oil is heated in any convenient manner to between 150 and 180 F., and maintained at this temperature while being circulated by the turbine auxiliary oil pump for from 4 to 24 hours or more, depending on the size of the turbine, or nature and amount of deposits. The oil may be heated by passing hot water through the water section of the cooler or by installing a temporary low-pressure (5 lbs. max.) steam coil in the oil reservoir. Venting devices and continuous by-pass oil purifiers, available as part of the oiling system, should remain in operation during the entire flushing period.

Oil piping, passages and parts in the governing system which come in contact with oil need to be cleaned. This should be done without danger of scoring the working parts of the governing mechanisms. During the flushing operation the pilot valves can be removed and the pistons either removed or blocked in their open position.

In some instances the high-pressure oil passages to the governor and other control mechanisms are blanked off during the early stages of flushing so as to have relatively clean oil for flushing the governor system. Toward the end of the flushing period, the blanks should be removed so the flushing oil can clean the oil piping and passages of the governing system.

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THE EVALUATION OF LUBRICANTS FOR USE IN COMPUTING MACHINES*

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Mr. McKibben received his B.S. degree in Chemical Engineering from the Ohio State University. Upon graduation he was employed by the National Cash Register Co. as a chemist, and, now, as Lubrication Engineer he spends his entire time on the study of lubricants, corrosion preventives, and their applications.

ABSTRACT: Computing machines are subjected to a wide variety of conditions, requiring a unique combination of characteristics in the lubricant to provide suitable operation of machines under all conditions. Methods of determining these various characteristics in the laboratory and their relative effect on operation of machines in product operation tests and in field service are described.

Computing machines are in use wherever men trade throughout the world. Such machines are not only exposed to the temperate weather to which we are accustomed, but to the heat and humidity of the tropics, which may be further aggravated by the salt atmosphere of coastal areas, and to the cold of Alaska, Canada, and Iceland. Low temperatures are a factor in computing machine operation where such machines may be used on the pump island of a gas station in Maine or Minnesota, in a milk delivery truck in Wisconsin, or in a meat packing refrigerator room. The lubricant must allow free operation of the mechanism at low temperatures, provide adequate lubrication without drainage at high temperatures, yet protect against corrosion in sea atmosphere at high humidities and temperatures.

These conditions and others inherent in the design and operation of the equipment are represented as gremlins riding a machine in Fig. 1. The design of these mechanisms may require that a positively driven part operating under 2500 lb. per sq. in. bearing pressure be adjacent to a spring actuated part with negligible load. The lubricant is expected to allow free operation of both without wear. Due to the nature of the equipment many parts receive little or no added lubricant over extended periods of time, and are subject to an accumulation of dust and/or paper lint. During these intervals the lubricant is expected to provide satisfactory lubrication without wear, yet not increase in viscosity sufficiently to cause interference with operation of spring actuated parts.

Due to climatic and design factors, and to the nature of the assembly process, it is necessary that the same lubricants be used on all machines, and desirable that as few lubricants as possible be used. At present a number of lubricants are used, but it is anticipated that one lubricant (and possibly dilutions thereof) may be found that will adequately lubricate the entire line of machines for all conditions.

The evaluation of lubricants is carried out under a four phase program consisting of Laboratory, Functional, Life Testing, and Field Service Evaluation.

LABORATORY EVALUATION: The lubricant used may have a wide range in viscosity but must not exceed 100,000 S.U.S. at operating temperature, or light spring actuated mechanisms will fail to function.

The viscosity of lubricants at low temperatures is determined on two instruments. A concentric cylinder viscometer with an alcohol bath is used to determine viscosities at temperatures well below zero, and at rates of shear below 50 reciprocal seconds. A disc viscometer[1] is used to measure the viscosity at 30 F. and a shear rate of 625 reciprocal seconds. This instrument is also used in evaluation of small samples of lubricant at room temperature[2].

An excessive increase in the viscosity of the lubricant during service, either by evaporation of light materials or by chemical degradation, would be cause for malfunctioning of the mechanism. To determine the comparative resistance to such an increase in viscosity, a gumming test was developed in which 1.5 milliliters of lubricant is distributed over the bottom of a 10 centimeter petri dish, and exposed in a forced draft oven at 157 F. for two weeks. The viscosity of the material is measured before and after exposure; a material showing an increase of more than 100% is considered unsatisfactory. Since the samples involved were much too small for conventional viscometers, the disc viscometer mentioned before, which can measure viscosity on samples of a few milligrams, was developed.

The corrosion prevention characteristics of lubricants are determined by means of a humidity cabinet meeting the requirements of a Government Specification JAN-H-792, formerly AN-H-31. Corrosion protection provided in salt atmosphere is also of interest, but equipment available does not provide sufficient reproducibility to give comparative data.

Since the inception of the company the materials used for product lubrication have consisted of the following:

* Paper presented at 7th Annual Meeting, ASLE, Cleveland, April 9, 1952.

MATERIAL	CHARACTERISTICS
Extra Light Lubricating Oil	Turbine Quality Vis.—150 S.U.S. (32 cs) @ 100 F.
Medium Lubricating Oil	Turbine Quality Vis.—200 S.U.S. (43 cs) @ 100 F.
Petrolatum	Melting Point—110 F. min.
Graphite Grease 64% Petrolatum 20% Medium Lub. Oil 16% Lubricating Graphite	Melting Point—105 F.
Graphite Oil 86% Extra Light Lub. Oil 11% Petrolatum 3% Lubricating Graphite	Vis.—250 S.U.S. (54 cs) @ 100 F.

In 1946 a new material was added to provide a grease type lubricant which would allow free action of spring actuated parts. This material was designated Light Graphite Grease and is prepared by blending 25% of Extra Light Lubricating Oil with the Graphite Grease described above.

In 1950, after extensive laboratory and field evaluation, a corrosion inhibitor was added to all the lubricants. This addition increased the corrosion protection of the lubricants a hundred fold, and was the first appreciable change in formulation of the lubricants in thirty years.

A grease, N.C.R. Lubricant 551, which is now on trial, and has been the subject of much laboratory work, consists of an oil having a viscosity of 150 S.U.S. (32 cs) @ 100 F. thickened with a microcrystalline wax and aluminum stearate.

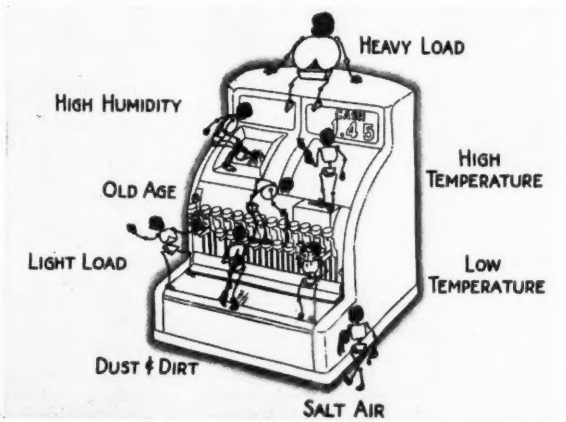

Fig. 1 Lubricants subjected to various conditions. Infrequent application of lubricants gives only occasional perfect operating conditions.

FUNCTIONAL EVALUATION: Laboratory data and functional data may be correlated to some extent. The effect of the gumming exposure, described above, on viscosity of two rust preventive materials is shown in Fig. 2. Gumming exposure of the same materials when applied to an assembly show a very similar effect on operating torque as seen in Fig. 3.

A room is available in which temperatures may be controlled at any point from −20 F. to 140 F. Either units or complete machines may be placed within this room to obtain operating data under any temperature desired.

Comparison of friction reducing characteristics is made on individual assemblies. The force required to operate the mechanism with various lubricants is compared with that required to operate the mechanism with no lubricant. A torque wrench was designed to measure the torque required to operate a given mechanism with different lubricants. It was found that the operating torque obtained with present lubricants could be reduced by 50% when using N.C.R. Lubricant 551. The force required to operate a keyboard mechanism with the present lubricant was found to be 136% of that required to operate it with no lubricant. In spite of this apparent advantage for eliminating the lubricant, it is necessary to lubricate the unit to avoid excessive wear over a period of time. It may be noted that this unit when lubricated with the N.C.R. Lubricant 551 required only 79% of the force required on the unlubricated unit.

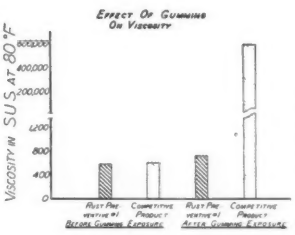

Fig. 2 (left) Effect of gumming on viscosity.

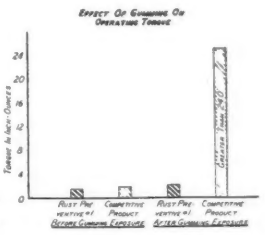

Fig. 3 (right) Effect of gumming on operating torque.

LIFE TESTING: The Product Testing Department provides facilities for life testing and for extensive functional testing of units or of complete machines. Most operation of machines is automatic, using a timing cycle and solenoids for actuation. However, in some cases manual operation is used to avoid the criticism that automatic operation does not properly simulate normal use. In one case an accounting machine was operated manually for 3,000,000 operations.

Dynamometers have been designed to determine the work required to operate completed machines. Such a dynamometer was used in comparing the work required to operate machines lubricated with different lubricants at low temperatures, see Fig. 4. It should be noted that the difference in work required at room temperature may not be claimed as an advantage for the lubricant, since different machines with the same lubricant show differences of this order. However, the great difference in rate of increase in work with reduction in temperature effectively shows the advantage of the N.C.R. Lubricant 551 at low temperatures. Comparison was also made of the operating force of these machines at intervals during a 5,000,000 operation test, but the results were not conclusive.

A comparison of the wear obtained over extended operation is made on assemblies with various lubricants. Where there is a wide variance in length of tests the data may be reduced to a common denominator such as inches of wear per million operations.

Fig. 5 compares the wear per million operations occurring on the Class 200 Keyboard with various lubricants. It is noted that solid lubricants are very poor when used dry, but may show some improvement when used in conjunction with other lubricants. The distribution of data obtained with two lubricants is as follows:

	Lubricant "A"	Lubricant "B"
Minimum wear, inches	.0017	.0015
Maximum wear, inches	.0064	.0071
Average wear, inches	.00280	.00255
Total number of wear points	16	16
Number of points within .0005" of average	8	3
Number of points within .001" of average	13	7

The slot in the guide plate through which the key operates is the point where the wear is measured. A metric steel scale was ground with a taper so that each millimeter which the scale enters the key slot in the guide plate beyond the initial measurement represents .0001 inch of wear.

FIELD EVALUATION: Although a lubricant may appear satisfactory throughout the above testing program, it is felt that it should be given a thorough trial under field conditions. Machines lubricated with a trial lubricant are placed in areas relatively near the factory such as Dayton, Detroit, and Cleveland. If no difficulty is encountered after a year's service, the trial is extended to include four machines in each of a number of localities throughout the United States. The distribution of these machines includes low temperature climates across the northern part of the country; high temperature, high humidity, salt atmospheres along the Gulf Coast; and the high temperature, low humidity climate of the Southwest. The servicemen in the field examine the trial machines at intervals and record observations on report forms, giving the following information: (1) Machine number and size. (2) Location of machine: Air Conditioned, Dry or Humid, Hot or Cold, Dusty, Kind of Business. (3) Ease of operation compared with that of standard lubricated machines. (4) Number of operations daily. (5) Requirement of lubricant replacement—location. (6) Complaints

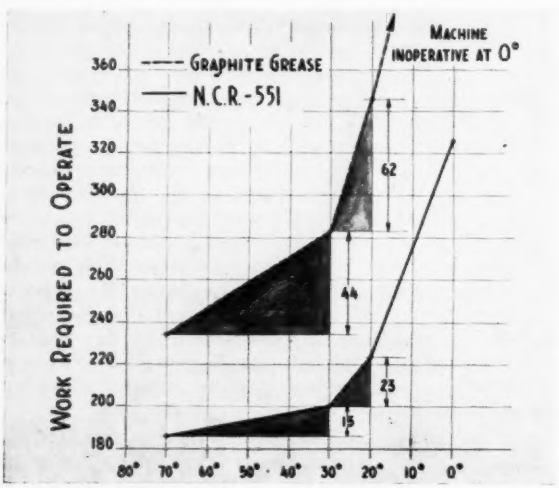

Fig. 4 Class 6000 low temperature operation.

which may be attributed to lubricant. (7) Amount of rust compared with that of standard lubricated machines.

CONCLUSION: It must be realized that the initial phases of this program are a continuing process of investigating new lubricants and surface finishes, or combinations thereof. However, the final phase is only initiated after supporting data from the earlier phases indicate that some lubricant, surface treatment, or combination, is sufficiently superior to the existing lubricant to warrant the effort involved.

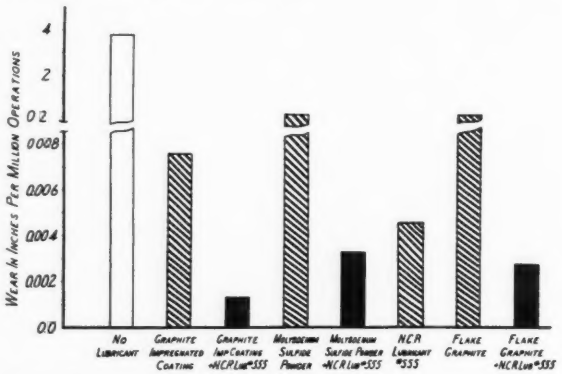

Fig. 5 Wear on Class 200 Keyboard Guide Plate.

It is felt that this program of evaluation of lubricants for use in computing machines will result in improved service to the customer with a corresponding improvement in good will toward the company, and, at the same time, greatly reduce service requirements in the field.

REFERENCES

[1]R. F. McKibben: Disc Viscometer. Lubrication Engineering, March, 1946.

[2]R. F. McKibben: Determining Consistency on Small Samples of Lubricating Grease. ASTM Bulletin No. 146, May, 1947.

ACKNOWLEDGMENT: The authors wish to express their appreciation to D. M. Forinash and R. W. Snyder of the Lubrication Laboratory, the Styling-design Department, and others within the company who assisted in obtaining data and preparing illustrations for this paper.

COMMENTARY by W. H. Millett, Carbide & Carbon Chemicals Corp.: The four-fold program of evaluation in the laboratory, in functional tests, in life tests and in the field represents the ideal approach to any product development problem. All too often, we who are associated with developmental activities are prone to overlook at least one of these important phases. This is particularly true of the fourth or "field" service evaluation phase. It is relatively easy to conduct the various laboratory tests, but the examination of product performance in actual field installations is quite another matter. This aspect is sometimes neglected and is often minimized. In fact, it sometimes seems that there is a growing tendency to rely on laboratory test results without first establishing adequate correlation between such tests and performance in the equipment in which the product is to be used. This paper clearly shows the importance that has been attached to the field evaluation phase of the overall development program.

It appears that most of the materials that have been examined fall into the general category of petrolatum plus a solid lubricant such as graphite or molybdenum disulfide together with selected inhibitors. Has the superiority of products of this type over such other possible lubricants as greases or greases containing dispersed graphite been definitely established? If so, what are the inherent advantages of the petrolatum-type lubricant?

In what directions, if any, are further improvements still needed? The last table indicated that, with the standard lubricated machines, a certain amount of rusting may be encountered. Does this indicate that still further improvement in rust protection is desired?

Extensive work has been done by the various military services on the utilization of diesters and other synthetic lubricant products as instrument oils. Have any of these products been evaluated for suitability as computing machine lubricants? If so, what are their particular advantages or disadvantages?

AUTHORS' CLOSURE: Dr. Millett points out that many of

(Continued on page 37)

EVALUATION OF DRAWING LUBRICANTS*

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Upon receiving his B. Ch. E. from the Lawrence Institute of Technology in 1937, Mr. Wojtowicz joined the H. A. Montgomery Co., where, in 1948, he was appointed Vice-President, Director of Research. He was awarded Research Corporation Fellowships in 1949 and 1950 at Wayne University, and is a member of ASLE, ACS, AAAS, Engineering Society of Detroit, Sigma XI and Phi Lambda Upsilon.

ABSTRACT: A method of evaluating drawing lubricants is presented which involves measuring the power required to draw a lubricated metal-strip through a pair of loaded, flat dies. It has proved to be very useful in making a preliminary assessment of drawing compounds, in investigating lubricant variables and in providing information for the intelligent formulation of new lubricants.

A discussion of both oil and emulsion type drawing compounds is presented. In the case of the former, high viscosity appears to be a characteristic feature of good lubricants for high pressure, low-speed drawing jobs. Polar characteristics of lubricants are best observed in conjunction with chemically prepared metal surfaces, e. g., pickled or phosphated. Polar additives, such as oleic acid, sperm oil and wool fat do not apparently improve lubrication with untreated metal surfaces. In the case of emulsions, the character and per cent of emulsifier is of the greatest importance in determining lubricating properties.

Type of diluents used in industry may seriously alter ultimate performance. Slight variation of surface roughness markedly influences the performance of emulsified compounds. In general, emulsion stability and lubricity are inversely related.

INTRODUCTION: There is a continuing need of a method of evaluating drawing lubricants quickly and reliably in the laboratory. Field or plant trials are unsatisfactory for the routine assessment of even a small fraction of the lubricants currently available. Further, such large-scale tests are completely unsuited for lubricant development work.

The present paper describes a practical drawing lubricant evaluation method which has been in constant use in our laboratories for a number of years and which has proved to be extremely valuable in the preliminary assessment of drawing compounds and in investigating lubricant variables. Basically it involves measuring the power required to pull a lubricated metal strip between opposing dies and is presented in the expectation that it will prove helpful to other workers in this field. It is also hoped that others will be encouraged in using this method and in developing it further.

EXPERIMENTAL METHOD: Fig. 1 is a schematic illustration of the testing device while a photograph is shown in Fig. 2. The apparatus is built around a 40 ton arbor press. The dies and screw-guide assembly are mounted solidly to the frame of the press to ensure permanent alignment under the heaviest test loads.

A wide variety of dies, in respect to metallurgical properties and design, have been examined and it has been found that plane surfaces on hardened tool-steel dies are the most satisfactory. The width of the bearing surface of the die, i.e., the length of travel of the strip over the die, is 2 inches. An entrance bevel with a radius of 0.25 inch has been found to be most satisfactory. A fixed force, in the range of 10,000 to 40,000 pounds, is applied to the upper or moveable die which corresponds to a pressure of 1,250 to 5,000 psi. on the metal strip. (Area of contact between the die and test strip is 8 sq. in.) This force is applied by the hydraulic mechanism of the press.

The die surfaces are prepared by methods commonly employed in commercial practice and include dressing with a tungsten carbide scraper and smoothing with Crocus paper. After each test, the dies are examined for galling, pick-up and scoring.

In cases where heat effects are to be studied the dies may be hollow and heated with circulating hot liquid.

The strip is 2" wide by 26" long and metals so far studied include mild steel, stainless, aluminum, copper, and titanium. In all cases, treatment of the test strips in any manner which may alter their surface properties will give rise to spurious results and must be avoided. The only preparation which test strips should receive is to remove the dirt and mill-oil by wiping with a dry cloth or washing with an inert petroleum solvent. Nicks or excessive roughness should be avoided by selection.

Both phosphate and pickling pretreatments as well as plain, untreated surfaces on mild-steel have been examined and important differences between them have been observed which are reflected in commercial operations. These will be discussed below in connection with lubricant evaluation.

The lubricant is applied by dipping, brushing, swabing or other appropriate method. In the case of emulsions, degree of drying before subjecting the strip to the test should be comparable to industrial practice. Oridinarily emulsions are used wet in the as-applied condition, but in some cases, such as the stainless steels, the emulsion may require drying before use.

As noted in the illustrations, the force for drawing the strip between the dies is applied through a toggle arrangement. The motor operating the speed reducer and mechanical screw has ample power to operate at essentially constant speed. The speed of the strip through the dies, however, is variable. It is low at the start of the test and rises to a maximum of about ten inches per minute. The downward speed of the mechanical screw is constant for all tests and is one foot/minute. The power required to pull the strip is meas-

* Paper presented at the 6th Annual Meeting, ASLE, Philadelphia, April 17, 1951.

ured by a recording wattmeter on the motor. The net energy consumed (watt-minutes) during the test is represented by the shaded area of Fig. 3 which shows a typical wattmeter record. Either the net energy consumed, or the ratio of this energy to the work done can be used to measure lubricity of the compound. In the latter case an abstract number is obtained which, disregarding the energy spent in permanent deformation of the test strip, represents an apparent coefficient of friction.

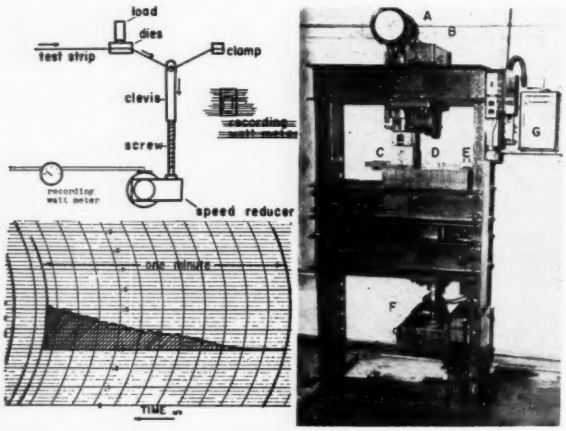

Fig. 1 (upper left) Schematic testing procedure.

Fig. 2 (right) Photograph of testing machine. Lubricating tests are carried out on a modified arbor press. Component parts of interest are: (a) pressure gauge, (b) manually operated hydraulic ram, (c) die assembly, (d) clevis, (e) locking mechanism of fixed end of test strip, (f) motor driver speed reducer, (g) recording wattmeter.

Fig. 3 (lower left) Typical test chart. Shaded area represents energy consumed during test; no-load power requirement for motor is 300 watts.

OIL-TYPE LUBRICANTS: Fig. 4 shows the relation between energy consumed and pressure, applied to the contact surface between the die and strip, for mineral oils varying in viscosity from 1400 to 5000 Saybolt Universal seconds at 100 F. The lines are essentially straight and pass through the origin thus indicating constant coefficients of friction for pressures up to 5000 psi. The efficiency of the oil increases as the viscosity is increased. The improvement is less in the higher viscosity ranges. For example, the improvement in going from 3000 to 5000 SU sec. is relatively slight. It is thus apparent that there is a point at which further increase in viscosity level does not significantly improve performance. This viscosity level is greater as the temperature is raised, as the roughness of the metal is increased, or as the speed of draw is reduced. The benefit of high viscosity, under appropriate draw conditions, is not restricted to mineral oils alone since polyisobutylene, polyglycol esters, blown vegetable oils, resin esters and other oily compounds follow the same rule. Under these conditions, the polar nature of the lubricant is of little significance.

Drawing lubricants may be classified in accordance with their composition into two main categories. These are: (1) oil-type and (2) emulsified. These categories may be further subdivided according to whether or not the compositions have mineral-type fillers. Products falling within these respective groups can be shown to possess certain related properties. The oil-type preparations are relatively simple to evaluate and to discuss. The other classes are perplexing and afford no a priori scheme of evaluation. It is improbable that a system of quality control can be established purely on the basis of chemical composition. It is even less certain that prior art can teach one anything about the significant factors of emulsion type lubrication.

EMULSIFIED LUBRICANTS: Emulsified lubricants are generally supplied in a concentrated form properly known as "soluble oil," "paste" or just "compound." They are diluted with either oil or, more generally, with water. In the latter case, the diluted product is known as an "emulsion." The method and degree of dilution have a profound effect on the performance of these lubricants and these factors are discussed below.

Emulsified lubricants have been extensively used in the cold-metalworking industry and particular appeal is accorded to "oil-in-water" type of emulsions. However, unlike the oil-type lubricants, it is impossible to classify them according to their physical properties so as to determine those which possess greater lubricity. An emulsified lubricant presents two discreet phases and, for the most part, the lubricating quality is more closely related to the extensive (water) phase than it is to the dispersed (oil) phase. Contrary to normal expectations, soap solutions fail under comparatively light loads during these tests and emulsions prepared with high viscosity oils are no better than those made with low viscosity oils (if the tests are made on diluted samples).

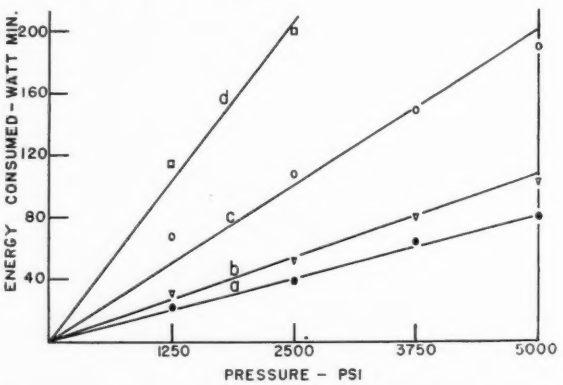

Fig. 4 Effect of viscosity on lubricity of oil-type compounds. Tests made on cold roll steel with fully refined paraffin oils. (a) 5000 seconds Saybolt Universal @ 100 F. (b) 3000 seconds S.U. @ 100 F. (c) 2000 seconds S.U. @ 100 F. (d) 1400 seconds S.U. @ 100 F.

The relative efficiency of emulsified lubricants may be connected with a hypothetical property which may be called stability under pressure. Those products which tend to break and release the dispersed phase (oil) under mild pressure and shear are considered to be of the preferred type. It may be possible to develop a stability-pressure-shear parameter which would correspond to viscosity-pressure coefficient in oils. The latter has been suggested to explain the preference of saponifiable versus the mineral oils.

Adsorption or chemical stability is another property which materially effects efficiency of emul-

sion lubricants. An empirical test, which is not free of ambiguity, is to determine the adsorbability of the dispersed phase. This may be done by passing the diluted emulsion through an adsorption column prepared with ground iron oxide scale. Emulsions which show only a slight tendency to wet the scale preferentially and to concentrate within the column have poor drawing characteristics. The dispersed phase of good lubricating emulsions is highly adsorbed by the column. These determinations can be made reliably only with dilute (high water-content) emulsions. The dilution itself may cause spontaneous coalescence of the dispersed phase and should be given consideration.

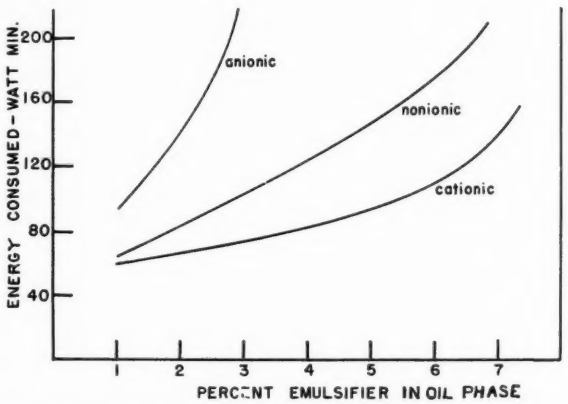

Fig. 5 Effect of concentration of emulsifier. Tests made on cold roll steel at 5,000 psi, using non-pigmented emulsion containing 67% water. Dispersed phase was a viscous paraffin oil.

A number of interesting experiments have been carried out in an effort to determine a line of attack for the formulation of emulsions of high lubricity. The first of these was the preparation of a series of emulsions in which the concentration of the emulsifier in the oil was progressively increased. Results of this type were obtained for various types of emulsifiers. The trends which have been observed are indicated in Fig. 5. It is evident that increasing the concentration of the emulsifier which, incidentally increases the stability of the emulsion, invariably decreases lubricity.

Emulsions may be classified to some extent in accordance with the type of an emulsifying agent which is used and the effect of the emulsifier concentration is quite different for the different classes of emulsifiers. Cationic emulsifiers have been found better that non-ionic and these in turn are better than anionic emulsifiers. However, with proper technique, satisfactory emulsions may be made with all classes of emulsifiers.

Lubricity of emulsions is also associated with the affinity of the dispersed phase for the metal. Cationic emulsions are characterized by having a dispersed oil phase which possess a positive charge. Since the lubricated surface is invariably negatively charged, one would expect a certain amount of attraction to manifest itself between the metal and oil droplets. Such an attraction would enhance preferential adsorption of the oil phase and thereby account for the better lubrication with cationic emulsions. However, it should be pointed out that even cationic emulsions lose effectiveness as the concentration of the emulsifier is increased.

The effect of surface roughness is most pronounced upon the lubricating properties of emulsified type compounds. Oil-in-water type emulsions are much more sensitive in this respect than are the invert, water-in-oil emulsions. An example of the effect of surface roughness on lubricity with oil-in-water emulsions is shown in Table I. The different degrees of roughness were obtained by abrading the metal test strips with emery paper. The abrasion was made at 45° to the direction of pull. As shown in Table I higher coefficients of friction were obtained with the rougher surfaces.

The problems associated with emulsion lubrication become increasingly more difficult to analyze when inert fillers are introduced. The ultimate character of the pigmented emulsion is dependent on the type of pigment, its ratio to the oil phase, type of emulsifier, and compounding procedure. It is possible to prepare compositions in which the filler may be uniformly dispersed throughout the two phases, or it may be concentrated within the oil phase or, in the last case, it may be concentrated at the interface. Variations in procedure alone may significantly alter emulsions. The probability that a given preparation has the same lubricity as a previous standard sample is inversely proportional to the degree of lubricating character it possesses. The most desirable lubricant emulsions require close control—the mediocre preparations the least.

TABLE II EFFECT OF DILUENTS ON LUBRICATING QUALITIES OF AN EMULSIFIED COMPOUND

LOAD (lbs.)	SAMPLE A		SAMPLE B		SAMPLE C		SAMPLE D		SAMPLE E	
	E	μ	E	μ	E	μ	E	μ	E	μ
13,300	14	0.05	24	0.09	32	0.12	54	0.21	70	0.27
26,700	34	0.07	42	0.08	54	0.11	100	0.20	164	0.33
40,000	42	0.06	60	0.08	76	0.10	120	0.16	212	0.28

SAMPLE A - Original compound before dilution.
SAMPLE B - Original compound A with equal parts of water.
SAMPLE C - Original compound A with two parts of water.
SAMPLE D - Original compound A with equal parts of low viscosity paraffin oil.
SAMPLE E - Original compound A with two parts of low viscosity paraffin oil.

TABLE I EFFECT OF SURFACE ROUGHNESS ON LUBRICATING QUALITIES OF AN EMULSIFIED DRAWING COMPOUND

LOAD (lbs.)	SURFACE ROUGHNESS R.M.S.					
	6 micro-inch		20 micro-inch		47 micro-inch	
	E	μ	E	μ	E	μ
5,000					173	1.91
7,500					236	1.65
10,000	100	0.53	187	0.99		
15,000			202	0.71		
20,000	112	0.30	224	0.59		
30,000	156	0.28	236	0.42		
40,000	220	0.29				

TABLE III TEST DATA ON PHOSPHATED TEST STRIPS; LUBRICANT IS A PARAFFIN OIL 1100 S.U.S. @ 100 F.

LOAD (lbs.)	NO TREATMENT		PHOSPHATE COAT	
	E	μ	E	μ
10,000	144	0.76	34	0.18
15,000	224	0.78		
20,000			64	0.17
30,000			80	0.14
40,000			110	0.15

E - Energy consumed in Watt Minute
μ - Apparent coefficient of friction

Table I (lower left) Effect of surface roughness on lubricating qualities of an emulsified drawing compound.

Table II (top) Effect of diluents on lubricating qualities of an emulsified compound.

Table III (lower right) Test data on phosphated test strips; lubricant is a paraffin oil 1100 S.U.S. @ 100 F.

As mentioned above, emulsified lubricants are generally supplied in a concentrated form and are diluted prior to use with either oil or water. The process of dilution in many cases brings about irreversible changes and alters significantly the lubricating quality. Surprisingly, water dilution is the least apt to alter lubricity. In most cases, the original lubricating qualities are retained over the workable range of dilutions and the principal effect of water addition is to reduce viscosity and to facilitate application.

Oil dilution, on the other hand, deteriorates

(Continued on page 41)

Progress Report:
JIC Hydraulic Standards, Part I

HYDRAULIC EQUIPMENT BUILDER'S VIEWPOINT*

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While serving an apprenticeship in the marine engineering field, Mr. Robinson acquired his technical background in the Royal Technical College of Glasgow, Scotland. Of the 23 years spent in this country, 22 of them have been in the employ of Vickers Inc., and he is now in the position of Chief Engineer. He took an active part in the compilation of the JIC Standards, co-operating with the manufacturers of hydraulic equipment and the automotive industry, while representing the machine tool builders as chairman of their Hydraulic Standards Committee.

ABSTRACT: From a manufacturer of hydraulic equipment's viewpoint, the adoption of the Joint Industry Conference Standards was based on sound engineering principles. There is no doubt that, although some of the hydraulic equipment manufacturers had initiated design change programs along the lines recommended by the JIC Standards, these conferences activated their efforts and introduced the thinking of the user of the equipment to these designs more than would have been possible without them.

If the nation in general and the engineering profession in particular were not operating under the stress of our national defense program, a much better comparison probably could be made between hydraulic equipment being used today and that being used in the period immediately following the last war. There is no doubt that the adoption of these Standards has imposed a heavy financial burden on most manufacturers, but fortunately the indications are that the selling price of hydraulic equipment has not increased with the improved articles; rather it is believed the price, in proportion to the inflationary tendency of all other commodities, is probably reduced. For this reason, the much felt scare of being forced to pay more to adopt these Standards has, from the equipment manufacturer's viewpoint, been refuted.

Whether or not service has been greatly affected will be discussed, although the general feeling is that as the adopted Standards are little more than three years old, service has not yet accumulated enough statistical evidence to be a worthwhile guide.

One of the recent productions of the motion picture industry, entitled The Day the Earth Stood Still, portrays a creature from another planet possessing the phenomenal power of stopping all machinery activity on this earth for a definite period of time. Similarly, our engineers and scientists are figuratively making the earth stand still, or at least slow down. Everyone is aware that the world is getting smaller and smaller relative to time, and in the not-too-distant future, with the use of planes which can travel at the speed of the earth's surface movement, it will be possible to leave New York and arrive at Los Angeles at the same hour as one left New York, or perhaps a little earlier. In this sense, the earth will have stood still.

Our aircraft industry will receive great credit for this accomplishment, and rightly so, but our machine tool builders and other branches of engineering must not be overlooked as being a very important factor in accomplishments such as this. Even we, as hydraulic engineers, will claim a certain amount of credit for these achievements, as we believe the art and application of hydraulics has done much to stimulate progress in many engineering fields.

Many of the recent advancements in hydraulics were certainly initiated or stimulated by the Joint Industry Conference Standards. This was due, to a great extent, to the more detailed picture of the thinking of the ultimate users which the J. I. C. provided for the designers of hydraulic equipment. From the viewpoint of a manufacturer of hydraulic equipment, the adoption of these standards was based on sound engineering principles.

In what might be termed the preamble to these standards, the statement is made that one of the main objectives is to promote safety of personnel. This particular objective has demanded a great deal more engineering thought than might normally have gone into the design of hydraulic components. However, a direct result of the issuance of these standards is that fewer accidents are occurring which can be directly attributed to faulty hydraulic equipment.

If the nation in general, and the engineering profession in particular, were not operating under the stress of our National Defense program, I believe a much better comparison could be made between the hydraulic equipment available today, after the advent of the J. I. C. and that which was available in the period immediately following World War II. However, several major engineering accomplishments are in evidence in the machine tool field.

The heart of every hydraulic system is usually the pump. Very often, like the human heart, the pump was imbedded deep inside the machine where accessibility was practically nil. Even to ascertain what type of pump was used was a cumbersome and difficult task. Although the accessibility of components is a responsibility of the machine tool builder rather than the hydraulic engineer, we as equipment manufacturers, in complying with the J. I. C. Standards, can supply duplicate name plates which can be mounted outside of the pump compartment. This eliminates the necessity of tearing the machine apart to find out what type or size of pump is used.

The opening statement under the "Protection" section of the standards is "Over-pressure protection shall be provided on the discharge side of all pumps." This is probably not as strong or forceful as hydraulic engineers would like to have it. While it is definitely beyond the scope of these standards to dictate design, the hydraulic manu-

*Sponsored by the Technical Committee on Hydraulics and Hydraulic Machinery and presented at the 7th Annual Meeting, ASLE, Cleveland, April 8, 1952.

facturer feels that pressure protection is a vital part of any circuit. Over-pressure protection automatically raises the question "How much over?" or "How much over what?" A fuse in most electric circuits is invariably a relatively definite value, probably within a small precentage of the number stamped thereon. In other words, independent of the make or manufacture of the fuse, a 5 amp. fuse will blow at approximately 5 amps., and not at some figure higher than this.

Unfortunately, such is not always the case in the selection of "fuses" in hydraulic circuits. Most pressure protection devices, which are hydraulic fuses, tend to override the initial design requirements; therefore the protection that the engineer thought was available might not be present. For this reason, it is desirable to have good over-pressure protection, making sure that the amount of over-pressure will be held to a minimum.

Thus it is stated in the standards that "it shall be impossible to adjust pressure controls outside of their nominal working ranges." This is a most sensible requirement, but is very often misinterpreted by both the user and the machine tool builder. Sometimes they get the impression that if they want a relief valve for, say, 949 psi., it should not be adjustable to 950 psi., whereas actually the valve may be designed to be adjustable to 1500 psi. and it will be so stated on the name plate. The fact that the machine tool builder cannot stand more than 949 psi. does not insure his getting a valve to meet these specifications unless it would be especially built for that purpose. If he had required 3-½ amp. protection in a fuse, he would normally expect the electrician to put in a 5 amp. one, but he would also make sure that no damage would be caused if 5 amp. capacity were ever reached. In the case of the relief valve, however, it can be adjusted to his exact requirements, and, provided he takes the necessary precautions of preventing tampering, he will have a fuse of exactly the capacity desired.

Although the internal working parts are unchanged, the design of many relief valves has been altered in terms of external shape and form to suit suggestions made by the J. I. C. Standards. The changes suggested by the J. I. C. were in recommending the use of what are commonly called gasket mounted valves. Although we hate to admit that anything ever goes wrong with hydraulic valves, the gasket mounted design enables valves to be removed without disturbing any of the plumbing in the circuit. The type of gaskets used are generally the synthetic rubber type of either "O" ring or pressure expanding type of seal. One hydraulic manufacturer has made mountings of this type for more than 20 years, and it is believed most manufacturers are now equipped to supply material in this category.

In the process of redesigning a great number of directional controls, the designers of hydraulic equipment found themselves faced with two J. I. C. Standards; first the hydraulic, and second the electrical standards. In many cases, designs that more than complied with the hydraulic standards were on the market, but they had to be completely redesigned when the electrical J. I. C. Standards were finally in force. This was not a case of the product being unsafe in its first design, but of being more safe in the final design form.

In this series of valves, the use of gasket mounted construction is proving itself invaluable compared to older piping methods. They can actually be gasketed one to another to combine several functions without the obvious disadvantage of miles of spaghetti. The same is true of other types of hydraulic components, such as volume regulators or control assemblies having several functions within them which control, in many cases, both direction and volume.

Unlike an all-electric machine, the hydraulically operated machine must contain a suitable place for oil storage. It is seldom piped in. For this reason it is necessary to have an oil tank. Probably as much time and thought was spent by the J. I. C. Group in the discussion of oil containers, more commonly called oil reservoirs, as with any other piece of hydraulic equipment. Poor design of an oil reservoir has been known to be the cause of many failures in other components, even to the extent of the condemnation of all forms of hydraulics. An oil reservoir must be designed properly. The opening paragraph in our standards under the section "Oil Reservoirs" reads: "A hydraulic fluid reservoir shall be designed and constructed in such a manner, etc." Although this point was not discussed, the sentence might have started and terminated with the simple statement: "A hydraulic reservoir shall be designed." Not just thrown together for the purpose of giving the oil a place to stay, but designed with the purpose in mind of insuring that the associated equipment will not be subject to malfunction because of poor reservoir construction. Too often the oil reservoirs were placed somewhere out of the way. It has to be admitted that most oil reservoirs are not beautiful but the majority have been redesigned to be works of art from the engineering standpoint. At present they are better suited to the desired work than they were "B. S." (before standards).

An example of common sense engineering was to elevate the tank from the floor simply to enable emptying it into a portable bucket without having to resort to machinery. When the tank is emptied, it should be cleaned. This should not necessitate the removal of any hydraulic component, but merely the removal of accessible clean-out doors, which should be large enough to conveniently permit thorough cleaning. Obviously, a sensible means of indicating oil level must be provided. While a dip-stick is good enough for an automobile engine and is very practical, it permits only periodic readings. A continuous reading sight glass or other means is now included, and a glance will tell whether or not it is necessary to add fluid.

These few items, from pumps through reservoirs, apply to all types of hydraulic equipment. For the information of those of you who may not be too familiar with hydraulics, it is really a very simple art. No matter how complicated the function or functions of a machine may be, they can be attained by controlling only three things in the hydraulic circuit, namely pressure, volume, and direction. The complexity of many hydraulic circuits does not change this statement, but merely requires that perhaps many pressures, varying volumes, and numerous directions must be considered.

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Progress Report:
JIC Hydraulic Standards, Part II

MACHINE TOOL BUILDER'S VIEWPOINT*

by K. O. Tech
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Mr. Tech received the degree of Bachelor of Science in Mechanical Engineering at the Lawrence Institute of Technology. Since 1939 he has been actively engaged in the design and development of Special Production Machine Tools at The Cross Co., a prominent machine tool builder. He is a member of The Engineering Society of Detroit, the SAE, and the American Ordnance Association.

ABSTRACT: This report will reflect: (1) The problems which existed prior to the development of the JIC Standards. (2) The methods used in utilizing the standards and the reconciling of the author's ideas with those expressed in the JIC Standards. (3) Accomplishments as a result of working with the JIC Standards. Typical of this was the redesigning of Way-Type Feed Units and Index Tables of the Fluid Drive Type.

In the years from 1930 to 1945, tremendous advances were made in the Machine Tool Industry. Many of these were made in the field of Special Production Machine Tools.

To a great extent, they consisted of gradually combining more and more machining operations into a single machine. This, in turn, required machines with provisions for automatic locating, automatic clamping, automatic cutting cycles and automatic material handling.

Because of its flexibility, hydraulic power was used almost exclusively for the above functions with electrical controls providing the necessary interlocks for automatic cycles. As a result of the adaptation of hydraulic and electrical controls, machine tools were developed with tremendous productive capacity at a low direct labor cost per part. However, their design for maintenance and for safety did not keep pace with the functional improvements. This resulted in an increase of indirect labor cost charged to these machines such as increased maintenance time, increased tool setting time and lost man hours.

The Machine Tool Builders were aware of the problems involved, were continually striving for better serviceability. In order to achieve this a great deal of dependable information was needed from Machine Tool users. This was received through service departments, from field reports and from customers. It represented, however, only a fragment of the entire picture.

With the development of the J.I.C. Hydraulic Standards for Industrial Equipment, there was obtained for the first time a complete picture of the portions of the machines which were giving the most operational difficulties. With these principles for guidance it was possible to accelerate the program for development of the finest possible Machine Tool equipment.

The J.I.C. Hydraulic Standards were utilized by considering them as a complete service report. If a particular component of hydraulic equipment or a hydraulic application was mentioned, it was felt that it would require close attention for improvement in design or application. A continual regard was maintained for the intent behind the various paragraphs in the Standard in order to improve on a literal interpretation of the paragraphs as written. In the development of new equipment, the objective was to make available the best and most flexible hydraulic and mechanical design possible rather than merely trying to make provisions for the minimum standards as outlined by J.I.C.

As a result of this, it has been possible in the last five years to completely redesign all the standard components utilized in the manufacture of Special Production Machine Tools. We have also revised our ideas as to how these components are combined in the final design of a machine.

A review of the procedure followed in the case of Way Type Feed Units and Power Index Tables should illustrate the progress we were able to make.

The Way Type Feed Unit is a unit providing a saddle or head moving on ways with hydraulic circuit provisions to permit rapid advance, two feeds forward, a dwell and a rapid return. These units are arranged so that they can handle drilling, boring, tapping and milling heads of various designs as may be required on a Special Machine Tool.

Prior to J.I.C. a typical unit of this sort was completely self-contained carrying a combination traverse and feed pump, directional control valves, relief valves and its own hydraulic reservoir. However, it was felt that the design should be reconsidered in the light of J.I.C. Standards.

The goals which were set in our redesign and their reasons follow:

1. To provide a truly accessible pump. In most units servicing the pump meant draining the oil from the reservoir first. J.I.C.—H3.3.1: (a) Pumps, or subassemblies including the pumps, shall be readily accessible for maintenance. (b) Pumps shall not be mounted inside reservoir.

2. To provide a truly accessible cylinder. In typical units, removal of the unit from the ways was required in order to change packing, and removing the cylinder required draining the reservoir. J.I.C.—H6.3.4: (a) Cylinders shall be accessible for servicing. (b) Cylinders shall be separate, not cast integral with equipment.

3. To separate completely, as far as maintenance is concerned, the electrical and hydraulic

*Sponsored by the Technical Committee on Hydraulics and Hydraulic Machinery and presented at the 7th Annual Meeting, ASLE, Cleveland, April 8, 1952.

components of related units. Generally speaking, hydraulic maintenance too often required the services of an electrician merely to remove the connections to the solenoids of a hydraulic valve prior to its removal from a machine. J.I.C.—H2.6.3: Hydraulic control units shall be mounted in positions which provide complete accessibility to all units for maintenance without interfering with adjacent equipment.

4. Elimination of any form of piping in the unit without resorting to lines manifolded in cast iron. Heretofore, internal pipe lines would leak and reduce the efficiency of a unit undetected. Past experiences had also shown that manifolded lines in cast iron housings were not any better. J.I.C.—H4.2.5: Multiple controls shall be mounted on a single plate within one enclosure whenever practicable to eliminate excessive piping.

A typical new design (Fig. 1) is illustrative of the line of units resulting from this development program. Our goals were achieved in the following manner:

(1) The pump and reservoir were removed from the unit, using in its place the standard floor mounted reservoir and tank assembly. Although it required additional floor space, it eliminated a special pump, the necessity for draining the tank for servicing and provided a unit with a design flexible enough so as to be used to perform other functions such as clamping, locating, etc., in addition to operating one or more Way Type Feed Units.

Fig. 1 (left) Way Type Feed Unit.

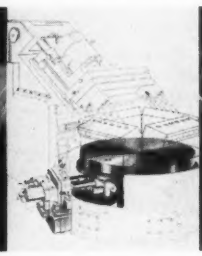
Fig. 2 (right) Removal of cylinder from unit.

(2) As a result of the cylinder design and manifolding, it was made possible to remove the cylinder without dismantling pipes, without draining the tank and without disabling any other part of the unit. So easy, in fact, that the simplest way to change the packing was to remove the cylinder from the unit. This is illustrated in Fig. 2.

(3) The combination of a gasket mounted control valve with the solenoids mounted in separate oil tight compartments permitted maintenance of either type of unit without disturbing the other. Use of a gasket mounted limit switches and elimination of conduit provided a clean and serviceable electrical circuit.

(4) Complete elimination of piping in this unit was attained by use of a steel manifold which connects readily to both ends of the cylinder. It connects the pressure, drain and tank lines to the cylinder, directional control valve and flow control valves. As illustrated in Fig. 3, the entire hydraulic system can be easily assembled and operated separately from the unit.

A similar method was used in the redesign of a standard Power Index Table. This table is used to index the work pieces from cutting station to cutting station in our dial type machines. In most machines the table is relatively inaccessible because, by its very nature, it must be surrounded by fixtures and tool heads. Prior to the redesign, fluid motor drive, shot bolt locating cylinders and timing and deceleration controls were located under the table which meant they would be located inside the base of the machine. Hydraulic valving consisted of three valves mounted outside the base and was connected by means of seven hydraulic lines to the unit inside the base.



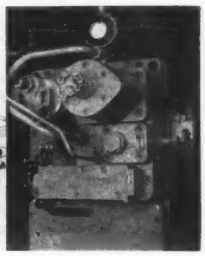


Fig. 3 (left) Hydraulic System.

Fig. 4 (center) Heavy Duty Index Table & Control Unit as applied to a dial type machine.

Fig. 5 (right) Control Unit—Power Index Table.

The index cycle of the table was as follows: Withdraw shot bolt, rapid index, decelerated index, stop, enter shot bolt. No provision was provided for easy reversal of the table direction.

Again, as in the case of the Way Type Feed Unit, we set the goals for our redesign:

1. Elimination of at least one valve with the resulting simplification of the hydraulic circuit.
2. To provide a table which could be reversed easily if it became jammed for any reason during indexing.
3. To provide a compact control unit outside the base, in an accessible position, which would contain the fluid motor for drive, shot bolt cylinder timing controls and all necessary control valves. J.I.C.—H4.2.5: Multiple controls shall be mounted on a single plate within one enclosure whenever practicable to eliminate excessive piping.
4. Separation of the hydraulic and electrical components of the control circuit. J.I.C.—H2.6.3: Hydraulic control units shall be mounted in position which provide complete accessibility to all units for maintenance without interfering with adjacent equipment.
5. Elimination of piping both within the control unit and between the control unit and the table. J.I.C.—H4.2.5: Multiple controls shall be mounted on a single plate within one enclosure whenever practicable to eliminate excessive piping.

A Power Index Table and Control Unit, as mounted on a machine, illustrated in Fig. 4 is the result. The Control Unit is shown in Fig. 5. Features of this redesign are:

(1) A new circuit was devised utilizing the

(Continued on page 41)

Progress Report:
JIC Hydraulic Standards, Part III

INDUSTRIAL EQUIPMENT USER'S VIEWPOINT*

by A. McHugh
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After graduation from the Henry Ford Trade School, Mr. McHugh worked as Tool and Die Designer for the Ford Motor Co. For the past seven years he has been employed by the Lincoln-Mercury Div. as Hydraulic Engineer and Control Applications Engineer and was selected as their representative at the Joint Industry Conference. He is Chairman of the Hydraulics and Pneumatic Sub-Committee of the Ford Motor Co., Manufacturing Standards Committee, and is a member of A. S. T. E.

ABSTRACT: The Joint Industry Conference was originated by a machine-tool and equipment user group. Minimum performance standards were established rather than detailed standards. The primary reason for the JIC's existence is to eliminate excessive production down-time.

The JIC has been in existence for about six years and a great deal has been accomplished. Standards have been set up in various fields but at present we are concerned with the hydraulic standards and their effect on the design and construction of equipment being delivered to the user group.

The availability of the hydraulic components for maintenance can readily be seen when observing equipment built to JIC Standards. Valves and piping are accessible. Hydraulic oil reservoirs are separated from lubrication reservoirs to prevent lubricating oil contaminants from getting into the hydraulic system.

Maintenance of the hydraulic circuit is made easier because of the circuit diagram sent with the equipment. The symbols are standard on all drawings, to avoid confusion. The various manufacturers use the same symbols for their hydraulic diagrams.

Ford Motor Co. has been receiving hydraulic cylinders with hardened rods. There has been less scoring and nicking of rods; therefore the leakage at the rod end has decreased accordingly.

Since the Ford Motor Co. has adopted the JIC Standards there has been a definite improvement in the production equipment. The down-time is less because of availability of the hydraulic components and improved circuit design.

Soon after machine tool builders started building machines with hydraulically operated and electrically controlled heads, clamps, and transfers, it became evident that certain standards for design and construction had to be established. The standards were necessary because of the excessive down-time on these machines due to inaccessibility of hydraulic components, poor functional design, vulnerability to damage and lack of information about the circuit.

Before discussing the progress of the J. I. C. it might be a good idea to check the conditions as they were before its inception.

We might first consider accessibility of the hydraulic components. It seems that the appearance of the machine was more important than ease of maintenance. Pumps were put inside of reservoirs which were often in the base of the machine. Four-way valves were often put inside the machine column, base or even in the oil reservoir. The location of the hydraulic components usually made the machine very difficult to maintain.

Another evidence of poor functional design was the common occurrence of a combination hydraulic oil and lubrication oil reservoir. The lubrication oil would drain back to the reservoir, bringing dirt, grit and other contaminants into the hydraulic oil. When separate reservoirs were used, there were no standards as to design or construction. Often the cover was just laid on top of the reservoir; consequently, rags, paper and other objects found their way into it.

Copper tubing and brass fittings were very often used as piping for the machines. The flare angles on the fittings were not the same. Some flares were 90 degrees and some 60 degrees. Pipe and tubing runs were left unsupported on some machines. The pipes were often used to support the hydraulic valves.

Hydraulic circuit diagrams, when they were furnished with the machine, had very little consistency. The machine repairman had to learn each machine builder's symbols to be able to read the diagrams. Very often he would give up and try to trace out the circuit on the machine itself.

The standards worked out by the user group, and later adopted with modifications by the J. I. C., were intended to rectify these various faults.

The Ford Motor Co. adopted the J. I. C. Standards as soon as they were published. All new machines had to be built to the new standards. Any machine to be reworked was also built to the standards.

When new machines were delivered and set up, it was immediately apparent that these machines could be maintained and serviced with a minimum of time and effort.

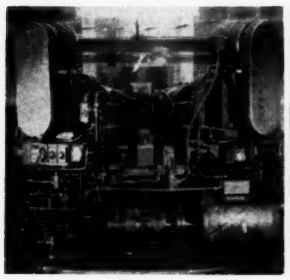
The control valves are in accessible locations, and are usually sub-plate mounted and manifolded. A valve mounted in this manner can be replaced without disturbing the piping. The time required to change a valve is 20 to 30 minutes.

The pumps are conveniently located for quick repairs. There are no interfering pipes or components that might make service and maintenance difficult.

The hydraulic oil reservoir is a separate unit of the machine. The hydraulic oil is not used to lubricate the ways, bearings, or other parts of the machine. There is a filtering circuit to maintain the hydraulic oil. With constant oil maintenance, there is less chance of pump and valve failure. Clean-out doors are large enough to make cleaning easy and they are accessible.

*Sponsored by the Technical Committee on Hydraulics and Hydraulic Machinery and presented at the 7th Annual Meeting, ASLE, Cleveland, April 8, 1952.

Machines built to J. I. C. Standards use manifolds when practicable. The piping that is necessary is done with cold drawn seamless steel tubing. Both flared and flareless fittings are permitted under the Standards. When flared fittings are used, they have a standard flare angle of 37 degrees. The machine builder must plan the piping arrangement on the machine to insure accessibility of hydraulic components, clean-out doors and any other compartments that are built into the machine. All piping runs must be properly supported.



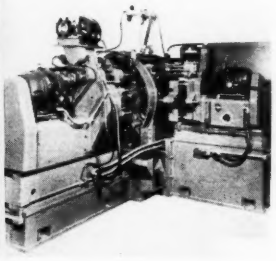


Fig. 1 (left), Fig. 2 (right).

Fig. 1 is typical of some machines in use before the J.I.C. Standards went into effect. The great number of chips and other contaminants on the hydraulic components is readily observed. No attempt was made to clean the machine or the area adjacent before the pictures were taken. The pictures show what is meant by inaccessible. In some cases piping must be removed before the valves can be serviced. The machine in Fig. 1 has the reservoir in the base and it is necessary to disassemble some of the piping and valves to remove the clean-out doors. Had the piping on the machine been properly planned, the production down-time would have been greatly reduced. The unsupported piping is subject to breakage when the machine vibrates in normal operation.

Fig. 2 is an illustration of a machine built to perform the same operations as the machine in Fig. 1. Both machines were built by the same machine tool builder. The difference between the two is that the latter is built to the J.I.C. Standards. The most apparent difference is the absence of most of the piping. The new machine uses manifold-mounted valves. The valves can be changed in a matter of minutes, whereas the comparable valve on the old machine required hours. I believe that these two illustrations show how much the J.I.C. Standards have helped the users of hydraulically operated machines to reduce production down-time.

It is also feasible to rebuild existing machines to conform to the new standards. Fig. 3 shows a machine as it was before being rebuilt. The hydraulic pump is located inside the reservoir. The 30 h.p. motor that is required to drive the pump is located in the column of the machine. The operating valves, which cannot be seen in this picture, were very difficult to reach for service or replacement.

When it was necessary to replace a pump, the machine had to be shut down for approximately 16 hours. The piping had to be removed and the motor disconnected and raised up the machine column. The reservoir cover was removed next and then the pump could be taken out of the reservoir. The machine was put together again after the new pump was installed and clean oil put into the reservoir.

The second picture of the machine (Fig. 4) was taken after the machine had been rebuilt to conform to J.I.C. Standards. The advantages of this design are readily observed. The hydraulic piping is well supported. The valves are accessible and they are manifold mounted. The greatest improvement is the new location of the hydraulic pump. The pump has been mounted outside the oil reservoir and is accessible for service. One man can service the machine, whereas a pump change on the old machine required the service of electricians, millrights and hydraulic men.

Fig. 5 is another of the new machines in the Dearborn Engine Plant. Again we see the oil reservoir out in the open for ease of service. The hydraulic oil filter is prominently displayed on this machine as in the other pictures.

The hydraulic oil filter is one of the most important elements in the hydraulic circuit. The filter takes out the physical contaminants that get into the hydraulic oil. There are filtering elements that will also remove acids that form in the oil due to oxidation.

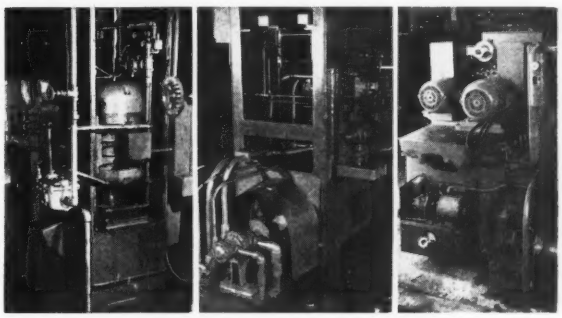


Fig. 3 (left), Fig. 4 (center), Fig. 5 (right).

If acids form in the oil, sludge and gummy substances will result. These materials will coat valves, pumps and other components, causing malfunctions in the hydraulic circuit. The hydraulic circuit is no better than the hydraulic oil, so it is very important that the oil be maintained as near refinery pure as possible. With a good filter and a sealed reservoir, the components in the hydraulic circuit will give long trouble-free service. In other machines, the safety factor has been emphasized in order that the operator may load and operate his machine without reaching across any moving or turning parts.

Before the designers complete a machine design, they send a preliminary circuit diagram to the control applications engineer for approval. The engineer checks the diagram to see that the machine cycle is correct and that everything conforms to the JIC Standards. After the design of the machine is completed, the machine is built and shipped. At the time the machine is shipped, a circuit diagram is mailed to the user. All the builders make their diagrams conform to the Standards so the user has very little difficulty in determining the proper operation of the machine.

Diagrams drawn to J.I.C. Standards must show

(Continued on page 42)

Lubrication Summarized

LUBRICATION PROBLEMS IN A BUS FLEET

by J. E. Spellman, Greyhound Inc., ASLE Baltimore Section Meeting.

Up to five years ago the diesel engine had many shortcomings due to poor lubrication: excessive oil consumption and smoking, oil pump failures and short unit or component life. Today the diesel engine is remarkably free of these faults primarily due to the introduction of chrome piston rings, better oil-control rings, roller-bearing idler-gears and the gear driven oil pump. The following remarks apply essentially to the GMC 671 diesel.

Much has been said about ring gaps but actually tests made not too long ago revealed not too much difference in oil consumption in the range say .025" and .040". The important requirement is that the cylinder-sleeve wall should not be glazed when rings and pistons are installed. Our practice is to roughen the sleeve wall with a 140 grit stone; this seems to enable the rings to achieve conformity without undue wear and definitely prolongs life.

Previously engine life was limited by the life of the idler gear bushing. No method of lubrication could seem to prolong it. Then someone conceived the idea of mounting the gear on ball bearings—it worked. Further research revealed that a double-thrust roller-bearing was even better, and today that is standard not only on our engines but I understand on all 671 engines in the field. Some of these gears and bearings on our engines have gone over half a million miles.

Formerly oil pump chain breakage claimed the life of many engines each year—today with geared-pumps and large pumps, engine failures from this cause are extremely rare and when they do occur can usually be traced to faulty installation.

Sludging has been minimized due to detergents and just a little more than two years ago we learned that the use of detergent oil (of the same weight as used in the engine) in the air cleaners would help to control carbonizing and plugging of air ports in the cylinder sleeves. This, of course, has helped to increase oil mileage and eliminate smoking.

On wheel bearings we not only use a bearing packer to pack the bearings but also pack the hubs. Grease in the hubs is not removed at wheel repacks unless it shows signs of water dilution or the presence of metal chips or other foreign bodies. Today our wheel repack period has been extended to as high as 50,000 miles where previously 15,000 miles was the prescribed limit.

It makes no difference how much we experiment, study, revise or plan our programs, the success lies in the hands of the mechanic or serviceman. Our problem is in training and supervising him to do his job as we want it done and the success of our lubrication or maintenance program is only to the degree that his performance conforms to our standards.

Our greatest lubrication problem is to convince the mechanics and servicemen of the absolute necessity for strict adherence to prescribed procedures. We attempt to do this by shop meetings, bulletins, personal instruction by the supervisors and also rigid checks.

AIR FILTERS & AIR FILTER OILS

by S. L. McDoniel, Sanitary District of Chicago, ASLE Chicago Section Meeting.

The Sanitary District of Chicago purchases all lubricants and processing oils by specification, laboratory tests, and field experience. Under this group is purchased a straight mineral oil for air filters with an approximate viscosity of 100 SSU @ 100 F. and one synthetic lubricant for air filters. The synthetic lubricant may be made from a petroleum base cresylic acid or from a coal tar base under the chemical name of tricresyl phosphate.

The primary requirement of an air filter oil is that the viscosity must be correct, within certain limits, for the particular type of filter with which it is intended to be used. The oil should retain its "body" within these limits throughout the range of operating conditions and temperatures. The oil should not evaporate to any extent, should not give off odors, and must be noncorrosive.

The optimum viscosity for our air filters has been found to be in the range of 250 SSU and control of the body of the lubricant is established by air tempering, heat exchangers, or dilution. When cold raw air is drawn directly through the air filter without tempering, it becomes necessary to dilute the charging body with a diluent in order to obtain efficient filter operation.

With the advent of warm weather, the diluted oil should be drained out and new undiluted oil replaced in the filter pans. Too light an oil will cause a dry top screen and oil carry-over under high filter face velocity. Likewise, too heavy an oil will cause poor screen draining and resultant oil carry-over. Normally our experience has been that filter face velocities of 650 FPM and over result in oil carry-over under most operating conditions. The desirable range has been to be around 400 fpm. for good over-all efficiency.

In air filters used for filtering diffuser air, the oil requirements are not as rigid as those intended for office use as the ultimate use of the air is for sewage treatment; i.e., odor is not too important.

Synthetic-type oil is used only where the air filter is inexcessible to the operating personnel over the week-ends and holidays as a means of insuring against loss in the event of fire.

LUBRICATION — YOUR JOB AND MINE (in part)

by C. T. Stone, Esso Standard Oil Co., presented at the Industrial Lubrication Conference, University of Tennessee.

There is nothing new about the necessity for lubrication. It was a vital factor in the westward expansion of this country. Lubrication of the axles of the old prairie schooners was essential to the transportation of families and equipment moving westward. Lubrication has been a tremendous factor in our industrial growth, for, without adequate lubrication, our production machinery would soon grind to a halt. Unfortunately, over the years, many of our designers and production men have considered lubrication somewhat of a mystery and have left it in the hands of

a few people to do the best they could—in many cases, without adequate knowledge of lubricants or the lubrication requirements of their equipment.

Today's business world is a competitive world. Regardless of the particular field in which we find ourselves, we are in a constant battle to offer something better than our competitors whether it is a new machine, a new product of consumer goods, or a new lubricant. We must never overlook this economic factor, because our companies and, therefore, our jobs will not last long if we are not competitive in price as well as in the quality of our products. Lubrication can be an important factor in both these points since it significantly affects the life of our equipment, the rate of our production, and the quality of our finished products.

While the sole purpose of the axle grease applied to the old Conestoga wagon was to "lubricate," or to provide a slippery film between metal or wooden parts and thus reduce friction and wear, today's lubricants are expected to do a great deal more than that. In the case of a grease, for example, its prime function, in addition to lubricating, may be to provide a seal to prevent the entrance of abrasive particles to the bearing clearances. In other installations, we may find no dust present, but there may be a great deal of water and it then becomes the added function of the grease to minimize the rusting of critical parts of the equipment. Or, in the case of oils, they may be called upon to provide rust protection or to insure cleanliness of the equipment over a long period of time in addition to their normal lubricating function.

OILS: Today's oils incorporate a wide variety of characteristics far beyond those described by such old terms as SAE 50 Pennsylvania, Steam Cylinder Oil, Compounded Oil, and the like. Modern refining methods, as well as the use of a wide variety of additives, have rendered these terms almost useless as a means of describing oils. Such terms as viscosity index (V.I.), detergent, oxidation inhibited, solvent extracted, and the like tell us a lot more about the product and its suitability to particular applications.

There are the other fundamental physical characteristics of oils such as pour point, flash point, carbon residue, all of which are fairly well defined, and all of which have their effect on lubricant performance. However, petroleum technology has been able to improve the relationship between these characteristics by modern refining methods and through the use of additives. For example, it is normally difficult to obtain both a high V.I. and a low pour point in the same oil. We have, however, been able to produce 100 V.I. oils having pour points considerably below those available in previous years.

GREASES: Much of our industrial lubrication is still performed by grease, and these products have not been overlooked in the development of lubricants to meet the requirements of modern machines. Many of you are familiar with the term "multi-purpose lubricant" and the term "extreme-pressure grease" and many others. Such products are a far cry from the old axle greases and they make it possible to fulfill requirements that could not have been met in years gone by.

It isn't enough that a grease do a particular job in a piece of mechanical equipment. Unfortunately, the dispensing properties of a grease are sometimes a critical factor in efficient lubrication. So, again, the lubrication engineer must keep in mind that, regardless of its ultimate performance properties, a grease can only do a job if it is in the machine and not frozen solid in a grease cup, or in the lines of an automatic lubricating system.

The petroleum industry maintains a staff of competent men to assist you in your lubrication problems. In most cases assistance is required only in the selection of proper lubricants. Many of today's lubricants are, however, the result of co-operative effort between the lubrication engineer and the design engineer where the development of a new and improved lubricant was required to insure the success of a new and improved machine.

MECHANICS OF LUBRICATION

(in part)

by C. L. Pope, Eastman Kodak Co., presented at the Industrial Lubrication Conference, University of Tennessee.

Lubrication functions under four basic conditions or combinations of conditions irrespective of the mechanisms: (1) Dry friction; (2) Boundary lubrication; (3) Fluid film lubrication; (4) Rolling friction. The engineer must thoroughly recognize in his design the mechanism of lubrication in these four categories before he can produce a successful economical machine. All too often the empirical formulae for design are accepted without the broad knowledge of how they came about, or whether or not they can be advantageously modified.

DRY LUBRICATION: It is well understood that dry clean metal surfaces having relative motion to each other, weld, gall, and score. Several things that we can do to aid in the operation of dry surfaces are as follows: (1) Use the hardest and best finishes that can be justified. (2) We may use a solid lubricant such as molybdenum disulphide where sulphur has an affinity for a metal such as iron, copper, silver, etc. The sulphur atom has a high chemical affinity for the metal without chemically combining in this case. This dry lubricant is particularly useful for micrometer screws, instruments, and electrical gear intermittently operated. It will not protect against rusting. Other dry lubricants used are graphite, mica, soapstone, and zinc oxide. (3) Various surface treatments of the metal surfaces are often helpful. A managanese - iron - phosphate coating, 0.00015" to 0.0003" thick, may be applied to ferrous metals. This provides a non-galling surface which allows mating surfaces to wear in without damage. This provides lower unit loads on the parts which is conducive to longer life.

BOUNDARY LUBRICATION: Boundary lubrication is a region of semi-lubrication in which some wear, high friction, and incipient failure may be expected. There is a choice of five types of lubricants for boundary conditions: (1) Lightly treated petroleum oils which will contain the maximum of unsaturates which have an affinity for the metal. Highly refined petroleum and synthetic oils do not function well under boundary lubrication, as they have little wetting ability. (2) Petroleum products which are

(Continued on page 45)

Book Reviews

HANDBOOK OF ENGINEERING FUNDAMENTALS (2nd Edition) by O. W. Eshbach. John Wiley & Sons, Inc., Publishers, New York 16, N. Y., 1952, price $10.00.

The HANDBOOK OF ENGINEERING FUNDAMENTALS has been a standard reference book for so many years that the thought of changing it would at first glance appear almost sacrilegious. However, even though basic fundamentals themselves do not change, viewpoints and methods of treatment do, and it is of course always possible to make additions to basic material.

Those familiar with the previous edition realize that this Handbook is a comprehensive summary of mathematics, physics and chemistry with complete mathematical tables, properties of materials and mechanics of solids and fluids. In addition, on the engineering side are presented fundamental concepts and formulations covering thermodynamics, electricity, fluid mechanics (hydraulics), aerodynamics and metallurgy. B. H. J.

MALEIC ANHYDRIDE DERIVATIVES by L. W. Flett & W. H. Gardner. John Wiley & Sons, Inc., Publishers, New York 16, N. Y., 1952, price $6.50.

The authors in the Preface to MALEIC ANHYDRIDE DERIVATIVES state that it is intended for students and research workers interested in synthetic organic chemistry and for industrial chemist confronted with the problem of finding suitable chemicals to solve specific problems.

From maleic anhydride, produced from the catalytic oxidation of benzene, chemists have developed a surprisingly wide range of products. These are important in the alkyd resins, in drying oils and as additives in organic pigments, lubricants, pharmaceuticals, wetting agents and numerous other products. This building block of organic chemistry is so important that a summary of the various associated compounds and reactions should be of real importance.

The book is prepared in a form so that various salts or radicals are carried through to desired end points with detailed discussion of procedures and uses of the intermediate and final chemicals discussed. Complete bibliographic references accompany the various sections. B. H. J.

Experiment & Experience

THE FATIGUE SPIN RIG—A NEW APPARATUS FOR RAPIDLY EVALUATING MATERIALS AND LUBRICANTS FOR ROLLING CONTACT BEARINGS. by E. F. Macks, NACA, 22758 Maple Drive, Fairview 26, Ohio.

A new apparatus of unusual simplicity permits evaluation of the fatigue life of balls and raceways in hours instead of months.

The apparatus consists of 2 or more balls in rolling contact within a raceway. Above the critical frequency of the system, the balls will space themselves to provide dynamic balance. The speeds, and consequently the contact stresses between the rolling elements and raceway, as well as the frequency of stress cycles obtainable with a simple air drive are enormous. Stress frequencies over 10 million per hour and contact stresses over 700,000 pounds per square inch (calculated Hertz) have been obtained. These stresses are due only to centrifugal force and occur over precisely defined contact areas. Such high frequencies and pressures in the absence of cage forces, unknown belt, shaft or housing loads, misalignment and deflection loads and other such imponderable but significant effects present in the usual testing systems, provide a means for the very rapid determination of a few variables that influence the endurance characteristics of materials.

The apparatus is easily adapted to very high or low temperature operation. Investigations of the effect of lubricant properties on endurance of materials and studies of lubricants for film strength and other properties may readily be made. Numerous other investigations regarding bearing life and reliability such as material comparisons, geometry studies, etc., may be made with the apparatus over wide ranges of variables.

Coming Events

FEBRUARY

12-13 Western Petroleum Refiners Assn. (Regional Meeting), Beaumont Hotel, Beaumont, Tex.

16-18 American Petroleum Inst. (Div. of Marketing, Lubrication Committee Meeting), Sheraton-Cadilac Hotel, Detroit, Mich.

27 Natural Gasoline Assn. of America (Regional Meeting), Scharbauer Hotel, Midland, Tex.

MARCH

2-6 American Socy. for Testing Materials (Spring Meeting), Hotel Statler, Detroit, Mich.

3-5 Socy. of Automotive Engineers (National Passenger Car, Body, & Materials Meeting), Sheraton-Cadilac Hotel, Detroit, Mich.

4-6 American Petroleum Inst. (Div. of Production, Southwestern District Spring Meeting), Hilton Hotel, Ft. Worth, Tex.

8-11 American Inst. of Chemical Engineers, The Buena Vista Hotel, Biloxi, Miss.

9-12 National Electrical Mfrs. Assn., Edgewater Beach Hotel, Chicago, Ill.

15-19 American Chemical Society (123rd National Meeting), Hotels Biltmore & Statler, Los Angeles, Calif.

15-19 American Inst. of Mining & Metallurgical Engineers (Annual Joint Meeting of Petroleum, Metals, & Mining Branches), Statler Hotel, Los Angeles, Calif.

16-20 National Assn. of Corrosion Engineers (1953 Conference & Exhibition), Hotel Sherman, Chicago, Ill.

19 National Industrial Conference Board, Netherland Plaza, Cincinnati, Ohio.

23-25 Western Petroleum Refiners Assn. (Annual Meeting), Plaza Hotel, San Antonio, Tex.

23-26 American Assn. of Petroleum Geologists, Socy. of Economic Paleontologists & Mineralogists, Socy. of Exploration Geophysicists (Joint Annual Meeting), Coliseum, Houston, Tex.

25-27 American Power Conference (Annual Meeting), Sherman Hotel, Chicago, Ill.

25-27 Socy. of Automotive Engineers (National Production Meeting), Hotel Statler, Cleveland, Ohio.

30-Apr. 1 Mid-West Gas Assn., Broadmoor Hotel, Colorado Springs, Colo.

APRIL

13-15 American Society of Lubrication Engineers (8th Annual Meeting & Exhibit), Hotel Statler, Boston, Mass.

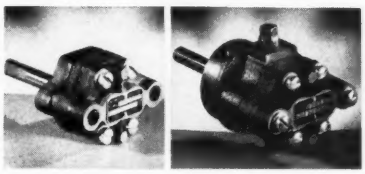
Lubrication in the News

A GUIDE TO BETTER FATTY ACIDS, a unique and timesaving device, a simple, yet complete catalog on fatty acids in a circular slide rule form which instantly gives chemical specifications and approximate composition of the various types of fatty acids, may be had by writing: Wilson & Co., Wilson-Martin Div., Snyder Ave. & Swanson St., Philadelphia 48, Pa.

A NEW CONCEPT IN GRINDING WHEELS, a new booklet containing valuable information for everyone interested in grinding — remarkable microphotographs, important research data, and a picture story of how Cincinnati Grinding Wheels are made—has been released. For copies write: Cincinnati Milling Products Div., The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.

C-40, a new lubricant developed for use on lithographing oven chains, softens carbon residues deposited on oven chains by petroleum oils in the past, making it possible to remove them easily. Contains colloidal graphite dispersed in a synthetic fluid of excellent lubricating characteristics; has a flash point in excess of 500 F.; has a carbon residue of less than 0.01% and is wax-free. It is non-toxic and can be stored for long periods without danger of settling; may be applied by brush, oilcan or automatic lubricating devices. Detailed information may be obtained by writing: Molyflo Corp., Greenwich, Conn.

DRAWCOTE, a new dry lubricant for use in metal forming operations, offers a radical departure from ordinary compositions, procedures and practices. When applied to metal and dried thereon, it forms a dry, protective and lubricating film; once coated, stock can be stored for long periods, then used as desired without any re-application or additional lubricant; it is easily removed from formed parts by a hot, mild alkali bath. For application: stock can be dipped in a hot aqueous solution, solution can be sprayed on, or you can flow the solution evenly over the surface. Complete information may be had by writing: Gilron Products Co., 6007 Euclid Ave., Cleveland 3, Ohio.



GEAR TYPE PUMPS: Two new gear type pumps, designated as the LAP and LAS Series (See picture: LAP left, LAS right), have been designed to suit a wide range of applications—pressure lubricating, oil circulating, oil filtering systems, lift systems, oil transfer, replenishing systems, etc. The LAP Series pumps are available in five sizes with capacities ranging from one-fourth to two gallons per minute to 1800 rpm. and 100 psi., and are recommended for pressures up to 200 psi. These pumps are designed for face mounting or wet sump applications. The LAS Series pumps are identical to the LAP except for the addition of an extremely efficient shaft seal, which recommends them for direct, gear or belt drives. They are also available as 115/230 volt motor-pump combination units. An internal relief valve is available which can be set between 50 and 200 psi. by a simple manual adjustment. This valve, however, cannot be used as a control or pressure-regulating valve. For further information write: Webster Electric Co., 1900 Clark St., Racine, Wis., Bulletin GP-1.

HOUGHTO-CLEAN 439 & 440, a newly developed "cold-cleaning" combination for the cleaning of metal parts in power washers at room temperature, effectively removes such soil as heavy drawing oils, pigmented drawing compounds, sulphurized cutting oils, rust preventives, and polar type smuts from ferrous metals, copper and brass. Because no heat is required, operating and maintenance costs are lowered — steam lines, ventilators, stacks, exhaust fans, etc., can be eliminated. For further information write: E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

MAGNETIC PIPE, DRAIN & FILLER PLUGS, ranging in size from ⅛" to 2" inclusive and made to original equipment standards in square heads, square countersunk, hexagon countersunk, slotted head, hexagon head, and specials styles; in cast iron, steel, malleable, brass, aluminum, and stainless materials; and "Dryseal" threaded, are again available. Made of the highest quality, high energy, sintered, permanent "Alnico" magnets sufficiently powerful to attract more than ten times their own weight, MAGNETIC plugs have no dissipation or leakage of magnetic force, are interchangeable with common pipe or drain plugs, and attract abrasive, ferrous particles directly from the oil or lubricant stream. For further information write: Magnetic Drain Plug Co., Wellington, Ohio.

MOLYKOTE LUBRICANTS, Bulletin 95, a new catalog on MOLYKOTE lubricants which includes complete technical information on all standard industrial grades and compositions, prices and packaging data as well as ordering instructions, describes MOLYKOTE, Type Z, the dry powder lubricant; MOLYKOTE, Type G, the grease consistency mixture; MOLYKOTE M-88, a dispersion of near-colloidal particles of Molykote powder combined with an organic binder in a volatile solvent; MOLYKOTE M-55, Molykote powder in a synthetic vehicle; and MOLYKOTE M-30, a dispersion of near-colloidal particles of Molykote powder suspended in a polyalkylene glycol vehicle. Copies may be obtained by writing: The Alpha Corp., 179 Hamilton Ave., Greenwich, Conn.

MOLYNAMEL: Tough, adherent, load-bearing dry-lubricant finishes may now be applied to any machine or instrument surface, using ordinary brush or spray techniques and without special equipment. A new lubricant-coating, MOLYNAMEL, puts a lustrous, hard, greasy-feeling but clean coating, from a fifth to half a thousandth of an inch thick, on any type of surface, over practically any kind

(Continued on page 46)

New Members

BODMAR, W. S., Bridgeport Lycoming Div., Avco Corp., Stratford, Conn.
BOHANNAN, D. R., Worthington Corp., St. Paul, Minn.
BOND, T. E., Ingersoll-Rand Co., Hartford, Conn.
BREWER, E. S., Brewer & Eliot, Inc., Boston, Mass.
BRITTAIN, C. C., Sinclair Refg. Co., Kansas City, Mo.
BROCIOUS, H., Co-operative Transit Co., Wheeling, W. Va.
CABBA, T., Sinclair Refg. Co., Detroit, Mich.
CARRIER, F. W., The Whitmore Mfg. Co., Cleveland, Ohio
CARROLL, A. J., Carrier Corp., Syracuse, N. Y.
COREY, T. L., Aluminum Co. of America, New Kensington, Pa.
CREAMER, E. V., The International Nickel Co., Inc., Huntington, W. Va.
DOWNS, E. M., Timken Roller Bearing Co., Canton, Ohio
ENGELHART, F., Northern Elec. Co., Ltd., Montreal, Que., Canada
ERCK, E. H., Bendix Aviation Corp., Teterboro, N. J.
GEACTINOV, C., Carrier Corp., Syracuse, N. Y.
HADYK, W., Carrier Corp., Syracuse, N. Y.
HAMMOND, G. E., Alemite Co., Buffalo, N. Y.
HARLOCK, A. D., F. Burkart Mfg. Co., Detroit, Mich.
HART, R. L., Sinclair Refg. Co., Jackson, Mich.
HILLIKER, W. P., Pan-Am Southern Corp., New Orleans, La.
HODGSON, C. D., Continental Oil Co., Ponca City, Okla.
JONES, F. R., Big "A" Co., Ltd., Hamilton, Ont., Canada
KAHLKE, J. H., The Texas Co., Chicago, Ill.
KARNES, E. B., Sun Oil Co., Chicago, Ill.
LENHARD, L. R., Penn-Petroleum Co., Detroit, Mich.
LESNICK, J. F., Co-operative Transit Co., Martins Ferry, Ohio
LLOYD, A. H., Nat'l. Steel Car Corp., Ltd., Hamilton, Ont., Canada
LONG, E. O., JR., U. S. Steel Corp., Pittsburgh, Pa.
MAINES, G. B., Socony-Vacuum Oil Co., Albany, N. Y.
MARTIN, J. L., Pure Oil Co., Berwyn, Ill.
McCLURE, E. W., Atlantic Refg. Co., Philadelphia, Pa.
McDONALD, A. T., Hughes Aaircraft Co., Culver City, Calif.
MEALS, R. W., Sinclair Refg. Co., Kansas City, Mo.
MERZ, C. J., Jr., U. S. Rubber Co., New York, N. Y.
MICKELSON, W. A., Cities Service Oil Co., New York, N. Y.
MOORE, W. A., N. W. Bell Telephone Minneapolis, Minn.
NAUGHTON, E. J., Carrier Corp., Syracuse, N. Y.
NICHOLSON, W. M., Alemite Corp., L. I. City, N. Y.
PARKHILL, W. A., Cities Service Oil Co., Marion, Ill.
PATTERSON, C. K., SKF Industries, Philadelphia, Pa.
PATTON, S. V., U. S. Naval Engrg. Exp. Sta., Annapolis, Md.
PIRIE, J. E., Honan-Crane Corp., Jenkintown, Pa.
PORCH, W. C., The DeLaval Separator Co., Poughkeepsie, N. Y.
PRESTON, F. C., Caltex Oil Pty., Ltd., Australia
RECCHION, E. L., Gulf Research & Dev. Co., Pittsburgh, Pa.
RICE, A. M., H. L. Blachford, Ltd., Toronto, Ont., Canada
RISS, G. A., Cleveland Graphite Bronze Co., Cleveland, Ohio
ROSTOWSKI, E., Milwaukee County Institutions, Milwaukee, Wisc.
ROUSE, W. F., Bridgeport Lycoming Div., Avco Corp., Stratford, Conn.
SHANHOLTZER, G., Socony-Vacuum Oil Co., Kansas City, Mo.
SHUMACKER, R. H., JR., Gulf Refg. Co., Fort Wayne, Ind.
SIMMS, H. C., Esso Std. Oil Co., Charleston, W. Va.
SKAUG, A. S., A/S Ostlandske Petrlm. Co., Oslo, Norway
SOLIS, D. W., Cities Service Oil Co., New York, N. Y.
SPADA, L., Spada Enterprises, Rocky Hill, Conn.
STROM, E. M., JR., Jos. Dixon Crucible Co., Philadelphia, Pa.
STURTEVANT, M. R., Norris-Thermador Corp., Los Angeles, Calif.
TEREN, G. G., JR., DeLaval Separator Co., Pittsburgh, Pa.
WENGERTER, F. J., Louis H. Hein Co., Ardmore, Pa.
WETZEL, J. H., Co-operative Transit Co., Wheeling, W. Va.
YODER, P. E., Acheson Colloids Co., New York, N. Y.

Patent Abstracts

Prepared by ANN BURCHICK from OFFICIAL GAZETTE, Vol. 663, No. 4; Vol. 664, Nos. 1, 2, 3, 4; Vol. 665, Nos. 1, 2, 3, 4. Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

OIL COMPOSITIONS CONTAINING STABILIZED COPOLYMER ESTER-TYPE POUR POINT DEPRESSANTS, Patent #2,615,843
by J. J. Giammaria, assignor to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing (a) a minor amount, sufficient to improve the detergent character of said oil, of a basic metal sulfonate and (b) a minor amount, sufficient to depress the pour point of said oil of an esterified copolymer which has been stabilized against the deleterious effect normally exerted on said esterified copolymer by the basic metal sulfonate in the oil, which effect reduces the ability of said esterified copolymer to lower the pour point of said oil; said esterified copolymer having been formed by reacting a vinyl compound, selected from the group consisting of styrene, 1-olefins, vinyl esters and vinyl ethers, with maleic anhydride in about equimolar quantities and then esterifying the copolymer thus formed with an alcohol material selected from the group consisting of primary, normal, saturated, aliphatic alcohols having from 12 to 14 carbon atoms and a mixture of primary, normal, saturated aliphatic alcohols having from 10 to 18 carbon atoms and an average of from 12 to 14 carbon atoms per molecule; said esterified copolymer having been stabilized by reaction of said esterified copolymer with from about 1 to about 10% by weight of a primary amine at a temperature of from about 125 C. to about 200 C., for a period of from about 1 to about 5 hours.

MINERAL OIL COMPOSITIONS CONTAINING ESTERS OF THIOPHENE-MODIFIED COPOLYMERS OF MALEIC ANHYDRIDE WITH ALIPHATIC VINYL COMPOUNDS, Patent #2,615,844.
by J. J. Giammaria, assignor to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing a minor proportion, sufficient to improve the viscosity index thereof, of the product obtained by (1) copolymerizing 1 mole of maleic anhydride with about 1 mole of an aliphatic vinyl compound in the presence of from about 0.25 mole to about 6 moles of a thiophene compound selected from the group consisting of thiophenes and alkyl thiophenes, to form a thiophene-modified copolymer product and (2) reacting the copolymer product with a compound selected from the group consisting of (a) primary, normal, saturated, aliphatic alcohols having from about 12 to about 18 carbon atoms, (b) primary and secondary saturated, aliphatic amines having from about 12 to about 18 carbon atoms and (c) a mixture of primary, saturated, aliphatic amines containing from 8 to 18 carbon atoms and having an average of about 12 carbon atoms per molecule.

LUBRICATING OIL ADDITIVES, Patent #2,615,845
by S. B. Lippincott & L. A. Mikeska, assignors to Standard Oil Development Co.

A mineral lubricating oil containing a minor proportion sufficient to increase the viscosity index and lower the pour point of said oil, of a relatively high molecular weight copolymer reaction product formed by reacting substantially equimolar proportions of maleic anhydride and a straight chain 1-olefin having up to 20 carbon atoms in the presence of a peroxide type catalyst and thereafter esterifying the copolymer with a mixture of saturated straight chain alcohols ranging from 10 to 18 carbon atoms, but having a major proportion of lauryl alcohol.

COPOLYMERS OF MALEIC ANHYDRIDE WITH ESTERS OF ITACONIC ACID AND SALTS THEREOF AS VISCOSITY INDEX IMPROVERS AND POUR POINT DEPRESSANTS, Patent #2,616,-849
by J. J. Giammaria, assignor to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing from about 0.1% to about 50% of a compound selected from the group consisting of a copolymer produced by copolymerizing maleic anhydride with a diester

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Personals

R. G. LARSEN, head of the Lubricants and Fuels Department at the SHELL DEVELOPMENT CO., Emeryville, Calif., has been selected to serve as Chairman of the Subcommittee on Lubrication and Wear of the National Advisory Committee for Aeronautics (NACA).

GULF OIL CORP. and B. F. GOODRICH CO. have announced the establishment of GOODRICH-GULF CHEMICALS, INC., a Delaware corporation organized for the purpose of exploring projects in the petrochemical field in which both companies have strong complementary interests.

C. A. GEISINGER, The B. F. Goodrich Co., Akron, Ohio, served as a Discussion Leader at the fourth PLANT MAINTENANCE CONFERENCE in Cleveland.

CARLISLE CHEMICAL WORKS, INC., Reading, Ohio, a subsidiary of The Cincinnati Milling Machine Co., has announced the appointment of TIONA PETROLEUM CO., Philadelphia, Pa., as their exclusive export sales representative on petroleum additives.

W. H. MILLETT, who has been engaged in research and development on Ucon synthetic lubricants and hydraulic fluids, has been transferred from the Tonawanda Laboratories of Linde Air Products Co. to the New York City offices of Carbide & Carbon Chemicals Co., both Divisions of UNION CARBIDE & CARBON CORP.

TRABON ENGINEERING CORP., Cleveland, Ohio, announces the appointment of J. G. BALDWIN as Regional Sales Representative in Georgia for the sale of Trabon centralized oil and grease lubrication systems and complete line of accessories.

SUN OIL CO., Philadelphia, Pa., has announced the appointment of W. B. DAUB as Assistant Advertising Manager for Industrial Products.

Promoted to new posts in the Petroleum Chemicals Department of AMERICAN CYANAMID CO., New York City, are: R. B. WAINRIGHT, Technical Director; V. R. FARLOW, Eastern Regional Sales Manager; E. F. HEIZER, Western Regional Sales Manager; T. O. McDONALD, Southern District Manager; R. LARSON & C. O. BROWN, Sales Representatives.

J. P. HAMER, J. D. OATHOUT, & H. L. LELAND, STANDARD OIL DEVELOPMENT CO., New Jersey, presented a paper entitled A Lathe Test For The Evaluation Of Cutting Fluids at the annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in New York City.

INDUSTRIAL LUBRICANTS CO., INC., Detroit, Mich., manufacturers of polishing cement, drawing compounds, cleaners, and rust preventives, has announced the appointments of W. C. KENNEDY as General Sales Manager, and H. E. EVANS as Chief Chemist.

OBITUARIES: C. W. ASHMANN, Shell Oil Co., San Francisco, Calif., 1952; H. COOPER, Sinclair Refg. Co., New York City, June 1952; A. S. JOHNSON, Freedom-Valvoline Oil Co., Milwaukee, Wisc., August 28, 1952; W. H. KRAUSE, Allis Chalmers Mfg. Co., Milwaukee, Wisc., November 1952; F. A. NICHOLSON, United Oil Co., Pittsburgh, Pa., July 25, 1952; G. E. PETERSEN, S. C. Johnson & Co., Inc., Racine, Wisc., December 1952; J. H. PRESTON, Sinclair Refg. Co., Jackson Heights, N. Y., 1952; G. B. THURSTON, The Ironsides Co., Middletown, Conn., 1952.

Current Literature

ADDITIVES FOR GREASES
by R. T. Macdonald & J. L. Dreher, INSTITUTE SPOKESMAN, Oct. 1952, pp. 12-13.

The article discusses the use of additives for greases which are needed to meet the lubrication requirements of modern machines. Although the additives used in greases are similar to those used in oils, such as gear lubricants, turbine oils, and motor oils, a higher concentration is usually required, and frequently the response is not the same.

ALL-PURPOSE CAPILLARY VISCOMETER
by J. F. Johnson, R. L. LeTourneau, & R. Matteson, ANALYTICAL CHEMISTRY, Sept. 1952, pp. 1505-1508.

A survey of the characteristics of capillary viscometers in common use in the petroleum industry led to the idea that the Zeitfuchs cross-arm type might be the all-purpose capillary viscometer. Originally this viscometer was designed for use only on opaque oils over the range of 2 to 37,000 centistokes. However, it has actually been continually used for over 3 years in the laboratories of the California Research Corp. as an all-purpose capillary viscometer covering the viscosity range from 0.5 to 100,000 centistokes, and operated at temperatures from −100 to 500 F. for both transparent and opaque oils. Table I summarizes the important features of seven of the more popular, commercially available viscometers in addition to the Zeitfuchs cross-arm type; Fig. 1 shows the constructional details of the various viscometers compared in Table I. The advantages of the cross-arm type are given.

AUTOMATIC FLASH-POINT INSTRUMENT
by R. B. Jacobs, OIL & GAS JOURNAL, Nov. 10, 1952, pp. 124, 126-128.

An automatic flash point device has been developed by Standard Oil Co. (Ind.) for use with petroleum products. The machine determines whether or not a sample of oil will flash at a predetermined temperature. Accuracy is comparable with that of the best laboratory methods, and the measurement (entirely automatic after a sample has been loaded) requires only 2½ minutes, as compared to about 20 minutes for the usual laboratory test. The new instrument is described.

BALL & ROLLER BEARING LUBRICATOR
by Anon, SCIENTIFIC LUBRICATION, Oct. 1952, p. 26.

Most ball and roller bearings are greased during assembly in the works, but they are not usually filled with grease sufficiently for putting into service. Consequently, they have to be filled during machine assembly and this is not always easy. The lubricator described is simple. An illustration is shown (drawing, photograph). Grease is forced down the central tube by means of a normal type of grease gun through the grease nipple shown. It exudes through holes provided and fills the reservoir below the bearing. Thereafter, all grease forced into the lubricator must be pushed into the bearing until it completely fills it and passes right through. This Alemite lubricator is now being made by Uni-Gun Lubricating Equipment Ltd., Coombe Bridge Rd., Beverley Way, Kingston-By-Pass Rd., London, S.W. 20.

BASIC CONCLUSIONS FROM THE CONTACT-HYDRODYNAMIC THEORY OF LUBRICATION GREASES
by A. E. Petrusevich, BIBLIOGRAPHY OF TECHNICAL REPORTS (U. S. Dept. of Commerce), Oct. 17, 1952, p. 99.

Translated by I. C. Lecompte. Available from Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $2.00, Photostat $3.75. PB 107389. (1) Lubrication—Theory—Russia, (2) Friction—Theory—Russia, (3) Navships T480, (4) STS 138.

BOUNDARY SURFACE STUDIES OF LONG-CHAIN POLAR COMPOUNDS, WITH REGARD TO THEIR BIOLOGI-

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Section News

NORTHERN CALIFORNIA: Nov. meeting — H. L. Southworth, Kingsbury Machine Works, spoke on Kingsbury Thrust Bearings in which he summarized the theory and historical development of oil-wedge lubrication and demonstrated applications of this principle in models which included air lubricated bearings and spherical bearings.

Dec. meeting—Presentation of section's charter to Section Chairman S. R. Calish, Jr., California Research Corp., by ASLE President M. E. Merchant, The Cincinnati Milling Machine Co. (See picture, from left to right: P. M. Ruedrich, Griffin Chemical Co., Sec'y-Treas.; J. A. Lettier, Shell Oil Co., Vice-Chairman; S. R. Calish, Jr.; M. E. Merchant; Mr. Resler, The Cincinnati Milling Machine Co.). Dr. Merchant then presented a paper entitled Cutting Fluids, Metal Cutting And Radioactive Tools. Excerpts include:

"Friction reduction and cooling action are two main functions of a cutting fluid. Depending upon the type of machining operation, the cutting characteristics of the work piece and the type of fluid used, either one or the other functions of the fluid controls the amount of heat produced in the machining operation, and thus tool life.

Tool life controls cutting costs. Whether considered from the number of pieces produced per unit of time, or the number produced between tool edge renewal or regrinding, tool life is the important factor.

The factors which influence tool life are the amount of heat developed during the cutting process and the rate of removal of that heat. As a chip is removed from metal, its structure becomes deformed first just ahead of the cutting edge and the chip is raised along the flank of the tool at an angle called the shear angle. If the shear angle is large, a thin chip and little heat will result. If it is small, a thick chip forms with considerable heat being evolved. The shear angle depends on: (1) Rake angle on the tool, (2) Characteristics of the metal, (3) Friction between the chip and the tool. Cutting speed also affects life; the higher the speed, the more heat developed and the shorter the life. Increasing the rate of feed, first increases then decreases tool life if measured in terms of volume of metal removed. If life is measured in units of time, the life is decreased. When cutting conditions become unduly severe, the cutting fluid which has the greatest heat removing ability is usually superior as it becomes more and more difficult to penetrate into the area of metal removal.

In testing the effect of cutting fluids on tool life, normally exhaustive tests consuming mountains of metal and considerable time are involved. Accelerated tests do not correlate, but conditions must be the same as those actually used in the operation. Radioactive tool tests accomplish this and hundreds of tests can be run in one working day. Since over 95% of the metal removed from the tool sticks to the chips, a radioactivity survey of the chips will indicate the wear which has taken place on the tool cutting edge.

In this work, a cut is taken on the end of a two inch piece of SAE 8650 steel tubing having a wall thickness of 0.2 inches. Feed is set at 0.0035 inches per revolution and a cutting speed of 400-800 FPM is used. By means of this radioactive cutting tool test, many useful and novel new products have been developed, and a better understanding of the factors affecting tool life has been achieved."

Jan. meeting—A Question & Answer Forum pertaining to problems related to: Automatic Lubrication, Cutting Fluids, Government Procurement, Industrial Greases, and Industrial Oils, with R. G. Larsen, Shell Development Co., as Moderator, and H. G. Isbell, Industrial Laboratory; R. K. McCoy, Lincoln Engineering Co.; J. M. Stokely, California Research Corp.; and C. O. Tindall, Food Machine & Chemical Corp., as panelists. (Submitted by P. M. Ruedrich, Sec'y-Treas.)

PITTSBURGH: November—Ninety-nine persons attended the Lubrication Engineering Conference sponsored jointly by the University of Pittsburgh, Dept. of Mechanical Engineering, and the Pittsburgh Section, Nov. 20 & 21 (See picture). The program was planned and executed by the following Conference Committee: J. Boyd, Chairman; M. C. Miller, Vice-Chairman; C. A. Bailey; J. Boal; H. B. Deakins; E. S. Francis; M. S. Hough; E. M. Kipp; J. D. Lykins; A. A. Raimondi; F. R. Ross; D. W. Sawyer; H. K. Siefers; G. L. Summer, Jr.; and N. L. Buck & T. G. Bekwith, both of the Dept. of Mechanical Engineering, Univ. of Pittsburgh.

The following papers were presented: Planned Lubrication In Industry, by E. M. Kipp, Aluminum Co. of America; Principles Of Lubrication, by J. Boyd, Westinghouse Research Labs.; Lubrication Principles As Applied To The Plain Bearing, by A. A. Raimondi, Westinghouse Research Labs.; Properties Of Lubricants, by C. E. Trautman, Gulf Research & Development Co.; Lubrication Application Equipment, by J. D. Lykins, Wheeling Steel Co.; Laboratory Testing Of Lubricants, by J. S. Aarons, U. S. Steel Co. The Conference included an inspection of the U. S. Steel Lubricants Testing Laboratory and was concluded with a dinner meeting with S. M. Weckstein, Timken Roller Bearing Co., speaking on Roller Bearings And

Their Lubrication. (Submitted by A. A. Raimondi, Chairman.)

BALTIMORE: Sept. meeting—C. W. Kelley presented a paper entitled The Preparation Of Specifications For Military Lubricants in which the organization of the Department of Defense is cited, particularly that part which handles specifications, and the Munitions Board and the three departments of the Army, Navy, and Air Force are especially considered. It was pointed out that The Standards Agency is charged with the responsibility to determine the procedure for the co-ordination of all specifications; that the quality of products required is dictated by the equipment and the anticipated conditions of service or operation; and that no greater progress has been made in the consolidation of any lubricant or related specifications than in the case of the corrosion preventives.

Oct. meeting — Lubrication Problems In A Bus Fleet (See Lubrication Summarized) was presented by J. E. Spellman, Greyhound Inc. (Submitted by W. C. Landis, Vice-Chairman.)

BOSTON: Nov. meeting—J. T. McElgin, E. F. Houghton & Co., presented a paper entitled Drawing Compounds Old & New And Their Applications. (Submitted by A. S. McNeilly, Sec'y.)

CHICAGO: Nov. meeting — Air Filters and Air Filter Oils (See Lubrication Summarized) was presented by S. L. McDoniel, Sanitary District of Chicago. (Submitted by A. B. Two, Sec'y-Treas.)

CLEVELAND: Oct. meeting — A plant visitation of the Goodyear Tire & Rubber Co., Akron, commencing with the Goodyear Exhibit which includes a rubber plantation, a tire museum, the company's products, a scene of Charles Goodyear's discovery of rubber vulcanization, and highlights of the company's growth as well as that of the rubber industry in general, followed by movies and a conducted tour of the truck tire manufacturing cycle at Plant One by the Squadron Training Group of Goodyear. (Submitted by B. B. Flick, Program Chairman.)

CONNECTICUT: Dec. meeting—J. C. Carpenter, The Vickers Corp., presented a paper entitled Hydraulic Oil Power And Its Industrial Application. (Submitted by A. H. Hoge, Sec'y-Treas.)

DAYTON: Nov. meeting—P. J. Hennessey and R. H. Dye of the Lubricants and Chemical Section of Quality Control, Air Material Command, Wright Patterson Air Force Base, spoke on Quality Control Of Lubricants From The Consumers' Viewpoint. Mr. Hennessey discussed specifications and the gaining of approval on products, and pointed out that the Air Force is cognizant of manufacturing facilities and their adequacy for the manufacture of good products as well as careful adherence to requirements as set down in specifications. Mr. Dye discussed the interpretation of specification stipulation and outlined the four levels of useability: (1) The product specification as stipulated, (2) Variations of minor sort which are permitted at the discretion of the inspection, (3) Deviations which are allowed from a realistic standpoint, (4) The use level under which products already belonging to the Air Force may be put to use even though they no longer meet the original specifications. (Submitted by A. H. Turner, Vice-Chairman.)

FORT WAYNE: Nov. meeting—P. V. Beltz, now with General Electric, presented a picture and story travelog, courtesy Uncle Sam, on From San Francisco To Wake Island To Korea And Back.

Jan. meeting—Technical session on Mass Marquenching held at the International Harvester Co., Fort Wayne, with speakers W. B. Cheney & W. C. Hiatt, both of International Harvester, followed by a trip through the Heat Treating Department. (Submitted by J. H. Wright, Sec'y-Treas.)

KINGSPORT: December—Industrial Lubrication Conference sponsored by the Kingsport Section and conducted by the College of Engineering, University of Tennessee, Knoxville (See Lube Lines, Lubrication Summarized.). (Submitted by J. E. Fleenor, Sec'y-Treas.)

LOS ANGELES: Dec. meeting—M. E. Merchant, The Cincinnati Milling Machine Co., ASLE President, presented a paper entitled Cutting Fluids, Metal Cutting And Radioactive Tools, illustrated with slides, followed by a movie entitled Fundamental Aspects Of Metal Cutting And Cutting Fluid Action. (Submitted by R. C. Dishington, Sec'y-Treas.)

MILWAUKEE: Nov. meeting — National President Nite, featuring M. E. Merchant, The Cincinnati Milling Machine Co., ASLE President, who presented a paper entitled Radio Active Cutting Tools For Rapid Tool Life Testing.

Dec. meeting—Annual Christmas Party. (Submitted by R. W. Schroeder, Sec'y.)

ONTARIO SECTION. Sept. meeting—C. R. Schablitzke, McColl-Frontenac Oil Co. Ltd., presented a paper entitled Selection And Application Of Lubricants.

Oct. meeting—Modern Circulating Systems—Or—Lubrication Insurance was presented by E. M. May, Bowser International.

Nov. meeting — G. R. Giles, Imperial Oil Ltd., presented a paper entitled Internal Combustion Engine Maintenance—Common Sense Practice.

Dec. meeting—Three speakers presented papers, as follows: T. A. Marshall, Steel Co. of Canada, Ltd.: Maintenance Of Circulating Systems; A. M. Fowler, Imperial Oil, Ltd.: Selection Of An Oil For Sparse And Flooded Lubrication; L. Beliveau, S. F. Bowser Co., Ltd.: Enemies Of Lubrication. The documentary Color film, Newfoundland Scene, which won the first award for non-theatrical films in 1951, and a turkey draw concluded the meeting.

Jan. meeting — Economic Handling, Storage And Dispensing Of Lubricants was presented by J. Boase, Lincoln Engineering Co.

Feb. meeting—T. J. Jones, Enjay Co., presented a paper entitled Additives And Their Functions. (Submitted by W. B. Dembner, Sec'y.)

PHILADELPHIA: Jan. meeting—J. B. Giacobbe, Superior Tube Co., presented a paper entitled Lubrication As Applied To Hot And Cold Metal Working.

February — Practical Lubrication Seminar. For the second consecutive year, a helpful sem-

(Continued on page 51)

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(Hibbert-McKibben, Continued from page 18)

the materials examined fall into the category of petrolatum, supplemented with a solid lubricant such as graphite or molybdenum sulfide, and inquires what the advantages of such mixtures are. In reply to this query it is again pointed out that for more than 50 years a mixture of petrolatum and graphite has been the basic lubricant used in the products of the authors' company. The great amount of satisfactory service provided by these products speaks highly for the lubricant used. Although there are many points at which this lubricant is found deficient under certain conditions of operation it has continued to be the basis of comparison. The NCR Lubricant 551, a grease, which is now on field trial appears to have several very distinct advantages over the petrolatum-graphite mixture.

The corrosion protection of machines which Dr. Millett inquires about was a definite problem prior to 1950, but is now adequately taken care of by the present lubricants which have a corrosion inhibitor added to them, or by the trial lubricant, NCR Lubricant 551, which gives excellent corrosion protection.

The ultimate in lubrication of computing machines is far from being reached. However, the practical demand which must be satisfied is "satisfactory operation of the machines under any normally expected operating conditions for the useful life of the machine." With this demand, the operating conditions and useful life of the machine expected, all in view, NCR Lubricant 551, the lubricant now on trial, appears to meet the great majority of the present requirements.

Several of the synthetic lubricants have been investigated, but of those examined none have indicated sufficient advantage to warrant extensive product testing and field trial.

Synthetic lubricants have been designed to meet excessive demands on one or two particular characteristics, with a deficiency existing in other characteristics. Thus, the silicones excel in chemical stability and viscosity index, but do not provide adequate lubricating or corrosion prevention characteristics for computing machine lubrication. In like manner certain synthetics are designed to provide the ultimate in non-spreading characteristics, but do not compare favorably in lubricating characteristics.

The diester lubricants, such as those meeting the requirements of Military Specification MIL-L-6085 are a well coordinated design, but of necessity are low in viscosity to meet the low temperature requirements. This low viscosity does not allow adequate lubrication over the extended periods between lubricant application encountered in computing machine use.

(Rosenstiehl, Continued from page 15)

After flushing, the governor parts, passages, etc. should be manually cleaned with lintless cloths.

A clue to the required duration of flushing may be obtained from a periodic check of the strainers and other oil purifying equipment. When successive inspections reveal no noticeable increase in deposits, it is reasonably certain that all contaminants have been removed from the system. Clean lintless cloth bags are often placed inside the strainers, their appearance during flushing giving a ready check on the progress of cleaning.

As soon as the flushing is completed, the oil should be drained from the tanks, coolers and oil purifying equipment while it is still hot, but venting should continue until the system returns to approximately room temperature. This will assure more complete drainage, as well as the removal of any impurities that may be oil-soluble at flushing temperatures, and will minimize condensation that could cause rusting. All low spots that could serve as traps must be drained and the accessible parts of the lubrication system inspected as thoroughly as possible, any remaining deposits being removed manually with lint-free cloths.

Bearings and piping may then be returned to their original locations, and assembly of the turbine completed. The turbine is then charged with a supply of clean lubricating oil of the grade to be used for regular operation, and given the customary operational checks accorded every unit before it is placed in regular service. At the conclusion of this step, many operators consider it good practice to make a final investigation of the cleanliness of the oiling system. When conditions permit, the oil may be temporarily removed from the system so that the latter can be given a thorough inspection. If this is impossible, or inadvisable, at least the strainers and oil purifying equipment should be checked for the presence of excessive or unusual deposits.

CLEANING DURING SERVICE (STATIONARY UNITS): In some instances, where a lightly-sludged unit cannot be taken out of service for a sufficient time for thorough cleaning prior to an oil change, continuous by-pass circulation of the oil in the system, through a clay filter, has been used to remove from the system solids and partially-sol uble oil degradation products. It should, of course, be appreciated that passing an inhibited oil through clay will remove the inhibitors, hence it is suggested that the oil supplier be consulted before employing this procedure.

Because the unit is in operation when such a process is followed, governor operation and bearing temperatures should be watched carefully, since solid particles may be loosened which would be large enough to restrict oil flow and interfere with operation.

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The used oil is drained from the system, which is then arranged so as to secure maximum oil flow and velocity to all parts of the assembly. This is done by removing the upper halves of the bearings and any restricting orifices, if used; or, if necessary, by rolling the lower halves of the bearings about the shaft sufficiently to uncover the oil supply passages. The bearing pedestal covers must be replaced to prevent leakage. At the same time, all tanks and sumps should be manually cleaned to remove as much of the deposits as possible, to avoid unnecessary circulation of such material while the actual flushing operation is under way.

The flushing oil (50-75% of normal oil charge) is then placed in the system and heated to a temperature of 150 to 180 F., by any of the means suggested previously. This improves the solvency of the oil and expands the piping and other parts, both of which contribute to the removal of the maximum amount of deposits.

During flushing, the dehumidifier system (if used), oil purifying equipment and strainers should be kept in continuous operation. Near the end of the flushing operation, the turbine should be rotated by the turning gear a number of revolutions equivalent to about one revolution of the ship's propeller, in order to facilitate complete flushing. In some cases, auxiliary filters, pumps and lines have been employed to assist in the removal of contaminants.

It is recommended that the hot flushing oil be circulated through the system for two hours, then stopped for one hour; and that this cycle then be repeated two more times. Following this three-cycle schedule, the oil coolers, bearing oil header, and oil strainers should be cleaned, since this will permit later inspection of their condition to serve as an indication of the progress in cleaning. Circulation should now be resumed and continued until the system is clean. This will be determined by inspection each six hours of the oil coolers, bearing oil header and strainers. At more frequent intervals the pressure drop across the strainer should be observed, as a ready clue to the rate at which deposits are accumulating. When deposits no longer accumulate on the inspected parts, the system can be considered clean. Approximately 48 hours overall is usually sufficient for a thorough cleaning, even under extremely dirty conditions. The use of a lance has been found effective for washing down interior parts of the gear casing and sides of the gears. Temporary fine-mesh strainers or lintless cloth bags may be inserted in lines during preliminary flushing.

When the system is clean, the flushing oil should be immediately drained while still hot, to promote complete drainage and to prevent oil-soluble contaminants from again becoming insoluble and precipitating out of the oil on the cleaned metal surfaces.

Immediately after draining, new rust-inhibited turbine oil of the grade to be used for regular operation should be put in the system and circulated for about two hours for displacement purposes. During this period, either the turbine should again be rotated by the turning gear as already described, or turned continuously by the turning gear during the flushing period. This will

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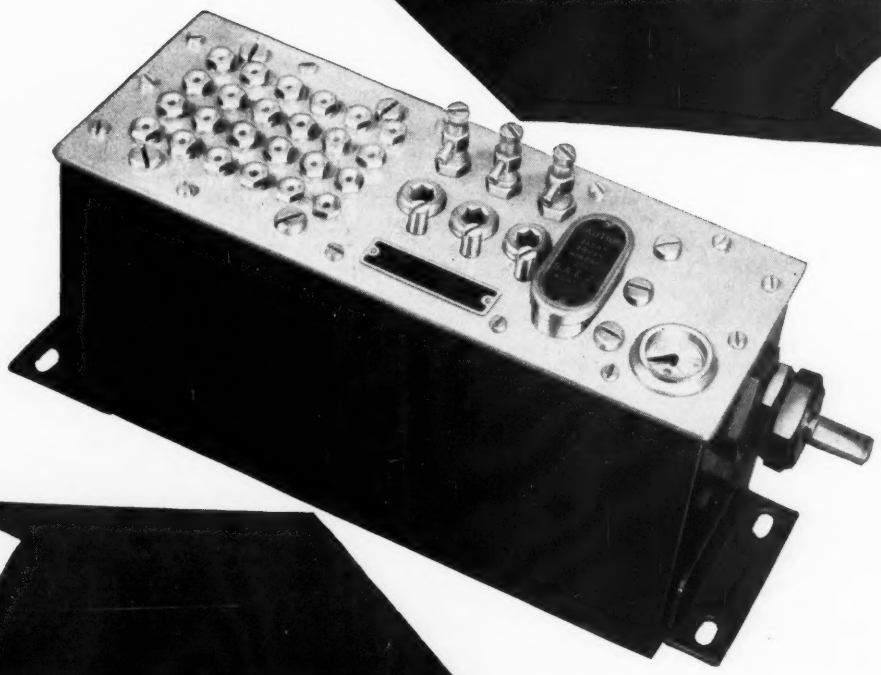

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establish on all lubricated surfaces a film of the same oil which will be used normally. The turbine oil used for displacement must then be completely drained, even from the low pockets that can serve as traps.

During flushing with turbine oil or with flushing oil and the displacement oil, as the case may be, the governing assembly should be cleaned in a similar manner to that recommended for stationary installations. Following the final flushing operation, the governor assembly should be cleaned manually with lintless cloths.

Any flexible shaft couplings should be carefully inspected for cleanliness.

After completion of flushing, an inspection of tanks, sump and accessible piping should be made. Remaining oil and deposits should be removed manually with lint-free wiping cloths. All parts previously altered to secure maximum oil flow should be returned to their proper condition, and the system charged with the correct grade of turbine oil.

In exceptionally dirty marine turbine systems, it has been the practice of certain commercial turbine cleaning companies to employ the use of powerful cleaning agents such as organic solvents or chemical solutions. In some instances certain of these materials are mixed with petroleum flushing oils prior to use. Such materials, while they may not dissolve the deposits, are often used since they will dissolve the materials which act as binders for the other solids such as rust, scale, dirt, etc. The successful application of such materials requires highly specialized knowledge and equipment and should not be attempted by those not fully aware of the hazards involved. In the past where suitable precautions have not been followed, serious damage has resulted due to corrosion of certain component parts of the system or due to the fact that it was impossible to completely remove from the system all of the cleaning agents used or the compounds formed by their use and these had a serious effect on the performance and life of the equipment and/or the turbine oil subsequently placed in the system.

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AUTOMATIC
LUBRICATION
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FOR MACHINE TOOLS, PUNCH PRESSES, PRINTING PRESSES, CONVEYORS, ETC.
LUBRICATION OF UP TO 24 HARD-TO-REACH BEARINGS STARTS WITH MOTOR SWITCH
Solenoid is connected across line of driving motor . . . and lubrication starts when motor switch is turned on. Single reservoir replaces many individual oilers. Smooth, easy hair-line adjustments on each feed valve through use of friction screw.
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MANITOWOC, WISCONSIN

(Robinson, Continued from page 23)

While on the subject of circuits, the symbols adopted by the J. I. C. have been extremely beneficial in the diagrammatic portrayal of machines. The older method of attempting to make a miniature picture of the outside of a valve or other type of control was very simple to those who were familiar with the inside of the valve. The new symbols, which graphically portray the operation of the valve, make circuit following and circuit analyzing much simpler and more easily understood once the alphabet of symbols has been learned. The writer has only one objection to the symbols as issued: When one line passes another and no connection exists between them, a loop or semicircular jumper should be used rather than a simple cross for the sake of greater clarity.

These standards have now been in effect for more than three years, and during that time the necessity for making elaborate cross-sectional type symbolic diagrams has only arisen once. Considering the thousands of circuits that pass through our circuit diagram group, this one is a very small fraction of a percent, and indicates the excellent job that the standard symbols are doing. Another indication may be in the fact that our sales and application engineers are so enthusiastic for the new diagrams that they request them from the Engineering Department rather than present their customers with their old freehand pictorial diagrams.

Maintenance and service is still a very important part of the functions of hydraulic equipment manufacturers. However our Service Department claims that the effect of the J. I. C. Standards is not yet enough in evidence to portray a good picture of how they have affected maintenance. This is probably due to the fact that in general the major portion of the equipment which is serviced is much older than the three to four year period which has elapsed. However, from the small amount of service which we have to do, it is apparent that decided benefical results have occurred and more are to be expected, due to the accessibility of hydraulic components with the use of the afore-mentioned gasket mounted construction. The redesigning, or perhaps we should say the proper designing, of reservoirs, including the relocation of inspection covers to make cleaning of filters simpler and easier, is another decided advantage.

However, it is still our contention that education is the primary factor regarding maintenance. None of you as plant superintendents or personnel in the master mechanic line would permit anyone but an electrician to perform even the simple chore of changing a fuse. While I will admit that most

of you, or probably all of you, are perfectly capable of changing the faucet in your kitchen sink, this type of hydraulic maintenance is in an entirely different category from power transmitting hydraulics. The necessity of allowing only hydraulically trained service men to make even minor adjustments of any hydraulic equipment should be emphasized.

ACKNOWLEDGEMENT: During the compilation of these standards the writer was privileged to represent his own company from the hydraulic equipment manufacturer's viewpoint and also attempted to represent the machine tool builders of this country as chairman of the National Machine Tool Builders' Association's Hydraulic Committee. This was a privilege and experience which will never be forgotten. We would like to take this opportunity to express our appreciation of the efforts of the various groups, particularly of the automotive industry, for their support of this program and the success with which the standards have been met and machinery improved in recent years as a result.

(Wojtowicz, Continued from page 21)

the lubricity in proportion to the amount of diluent added. The decrease in lubricity reaches asymptotically a value which is equivalent to that of the pure diluent. Table II shows the effects of oil dilution and water dilution of the same compound. It is evident that oil dilution has more effect upon the lubricating properties of an emulsion type compound than water.

CHEMICAL TREATMENT OF METAL SURFACES: The advantage of conditioning metals, in preparation for drawing, by chemical treatment so as to produce a highly adsorbent surface can be well demonstrated by tests of this type. Oxide, sulfide, fluoride, oxalate, and phosphate processes have been investigated and found in all cases to be beneficial. Table III gives the energy-pressure characteristics of a mineral oil on a mild-steel test-strip before and after it had received a phosphate-type coating. The magnitude of this effect is dependent upon many factors associated with the formation of the phosphated coatings and at times it is difficult to reproduce an optimum result. In actual practice, the chemical nature of the phosphated coat also inhibits scoring. The latter phenomena cannot be quantitatively evaluated by the suggested procedure, and therefore, some of the conclusions have to be made with reservations. This shortcoming has not, however, detracted from the proved usefulness of the test procedure described. It is expected that, as more experience is gained, methods of overcoming these present faults will be found.

CLOSURE: There are a number of shortcomings with a tester of this type. For example, it appears impossible to detect or distinguish between the so-called conventional lubricants and the boundary lubricants. Further, such additives as graphite do not produce any appreciable lowering of the frictional properties. The same discrepancy is noted when E.P. agents are added. These observations are in contradiction with shop results. The explanation is probably that the unit loadings in the test are too low and boundary lubrication conditions are not established. It is only under the latter conditions that polar additives manifest their superior characteristics.

The data obtained from these tests has been found to be very reliable when applied to the evaluation of drawing compounds which are used in stampings, forming, and rolling operations. Data obtained from tests, when extended to such operations as seamless tube drawing, wire drawing or cold extrusion, is less dependable. However, even here it is possible to screen out the undesirable products by such tests, leaving the ultimate selection to a production test.

ACKNOWLEDGEMENTS: Due consideration should be accorded to Mr. H. A. Montgomery for his valuable technical assistance in the development of the testing equipment, to Mr. A. D. Gaskin for many valuable suggestions at the early stages of the development, and to Mr. A. Fucinari who compiled most of the data presented. Surface roughness measurements were obtained through the courtesy of Dr. C. R. Lewis of the Chrysler Corporation.

(Tech, Continued from page 25)

Standard Cross Direction Flow Control Valve to provide forward and reverse action to the shot bolt and rapid index and decelerated index. This valve was operated by two solenoids enclosed in an oil tight compartment and by dogs on the timing shaft during automatic cycle. Manual control was provided for the operator during set-up operations.

(2) In addition, this circuit has two hand-operated valves which can be reversed from their normal position. This action controlled by the manual table operator provides reverse action of the table.

(3) The control elements of this circuit: the fluid motor, the shot bolt cylinder and the timing mechanism, were designed into a complete unit to be carried outside the base, connected to the table through three spline drive shafts which can be disengaged easily for removal of either unit.

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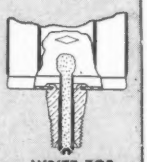

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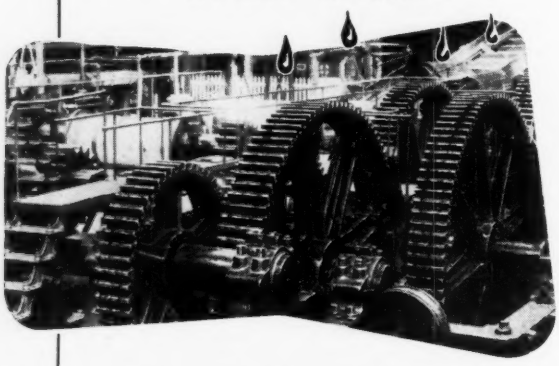

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The following case history is significant:

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(4) Again, use of a gasket mounted valve with solenoids mounted separately in oil tight compartments simplified the hydraulic maintenance problem. Again, this together with the use of gasket mounted limit switches and no use of conduit gave us the same result electrically.

(5) Since it was possible to combine the controls and drive elements into one unit, no hydraulic connections were required between this unit and the table. Hydraulic piping in the unit itself was eliminated with but one exception. Controls had to be connected to the fluid motor through standard piping since no motor was available which would provide a manifold mounting. These three connections were simple, external, and held to minimum length.

Similar goals were set for the designs of complete machines which usually contained a number of these standard components. Many of these have been attained. Others are still being worked upon in the never ending search for the better design.

But whether it be standard units or complete machines, the J.I.C. Standards for Industrial Equipment have made possible a great contribution to the advancement of design by pointing out the many minor and yet important trouble spots in machine tools. After working with them since 1948, we have reached the following conclusions:

They are a practical set of standards, easy to work with, if approached with the proper attitude.

They are not restrictive in design. They offer wide leeway for the initiative and ingenuity of the designer.

Their development and enforcement by various industries have been a great factor in improving and assuring a high standard Machine Tool design. Considerable progress has been made in improving serviceability and operation of machine tools since 1948 and a good share of this improvement can be traced to the opportunity to work with J.I.C. Standards.

(Morrow, Continued from page 13)

from operating conditions (pressure, temperature, speed), optimum performance of a premium lubricant in a well designed system is realized only through the elimination of various contaminants. Therefore, the dissemination of information on cleaning procedures is one which the ASLE, by virtue of its position in industry, should seriously consider.

(McHugh, Continued from page 27)

the following: (1) Hydraulic components in symbolic form for easy tracing of flow path. (2) Operating pressures. (3) The sizes of cylinder bores and rods, and length of stroke. (4) Pump delivery and reservoir capacity. (5) Piping sizes. (6) Complete catalog information on hydraulic components. (7) Operating characteristics of related electrical equipment. (8) Complete sequence of machine operation in text form, on diagram or attached.

The information given on the diagram aids the maintenance man when he is working on the circuit. The engineer can analyze the circuit better when he has all the information on a diagram.

The design of hydraulically operated machines is constantly being improved by the machine

builders. The job of maintenance is made easier because they are being built to conform to the J.I.C. Standards. As long as the machine tool builder knows that the user wants his machines built to the Standards, he will continue his good work in design and construction.

(Lube Lines, Continued from page 9)

qualities, and deep interest in rockets and jet propulsion. Applications, which may be secured from The Daniel & Florence Guggenheim Foundation, 120 Broadway, New York 5, N. Y., must be received by March 1, 1953, and will be acted upon by April 1.

ORGANIZING FOR PRODUCTION MAINTENANCE:[1] The evolution of high speed production has brought about a refinement in the meaning of the word lubrication. Inadequate understanding of what is meant by lubrication and its role to modern day production is too frequently responsible for the unfortunate confusion that contributes to high maintenance cost and low production. Probably to better define the word lubrication, one should drop the technical or Webster's meaning, and coin a completely new definition with the scope in mind of placing the giant of the oil industry in line with the present productivity factors known to management. Upon the productivity of modern machining depends the efficient operation of that machinery. Therefore, the phrase Production Maintenance is far better when lubrication is used to prevent maintenance and keep our equipment operating at top speed. In the days of low speed machinery, the squirting of oil from a dirty oil can into a bearing hole or smearing grease on a surface was probably an adequate system for the time. Today high speed operations force us to organize our work in lubrication in order to keep an efficient operation of a plant.

Every phase of lubrication maintenance should be carefully analyzed for the particular shop or plant before a service program is planned. HOW TO START STUDY: (1) Get acquainted with maintenance personnel by providing the individual with an office planned and organized for business; make the individual feel like he is a professional man. Remember most of our troubles in lubrication begin because of poor housekeeping and untidy individuals. Divert industrial magazines and articles dealing with the problem of lubrication for stimulating ideas. (2) Train personnel to keep records; simplify record forms—combine maintenance and lubrication. Schedule office time for this duty. (3) Provide complete lubrication charts for each individual machine, along with an operators manual. Get service men acquainted with the function of the various parts of each machine. This will bring new ideas for maintaining. (4) From study of lubrication charts, select minimum types of lubricants for total equipment involved. (5) Plan area for bulk storage, keeping in mind some of these factors: safety regulations; variations in temperatures; material handling equipment; size and shape of containers; over-all considerations such as receiving, storing, processing, shipping; locations for service tools; material identifications (Use color dynamics). (6) Plant Housekeeping: Although the plant engineer may be responsible for the housekeeping program, he must

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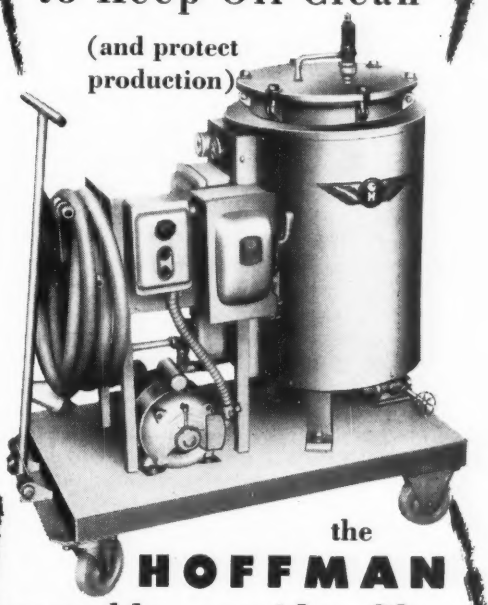

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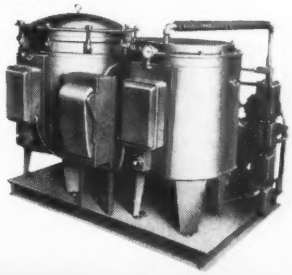

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depend on the interest and activity of others in order to make the program effective. Therefore, good housekeeping must be accepted wholeheartedly as a company policy and actively sponsored by top management. Cleaning is an investment in durability. Grit and dirt around machinery soon convert lubricating oils into cutting compounds. (7) Design service carts for two purposes: for transporting supplies to machines, for transporting maintenance equipment and supplies for lubricating systems. Include file for records in each; include equipment for all systems of oiling required for the plant; make carts attractive so operator takes pride in his equipment. (8) Train oilers in the art of wiping and cleaning. (9) Acquaint oiler with: selection of lubricants, systematic lubrication, control of oil consumption, lubricating mechanics. (10) Other factors to consider: (a) Environmental Factors: reason for good housekeeping; economic gains or losses by color applications; order, housekeeping, visibility; increased productivity. (b) Behavioristic Factors: improve employees' work habits —reduce accidents; improve employee moral; improve employees' vision; esthetic and psychological effects.

[1]Presented by O. D. Lascoe, Purdue University, at the Industrial Lubrication Conference, June 8 & 9, 1952.

PARTIAL EXPLANATION FOR ENGINEER SHORTAGE: There has been considerable discussion in technical publications concerning the shortage of engineers and the problem it is creating in industry today. Many look forward to the future with trepidation and wonder if we are going to be able to handle the technical advances which are "just around the corner" without an ever-increasing supply of engineering personnel. Most of the discussions encourage the engineering schools to increase their enrollment, offer more varied courses, and other such devices to make more engineers available after graduation. They seem to overlook one of the basic problems recently uncovered in a survey of high school education: that only 20% of all high school students take mathematics, only 12% enroll for chemistry, and 5% take physics. This is a partial explanation for the dwindling supply of engineers. Our young people should be encouraged to take these basic courses which will enable them to enroll in technical schools upon graduation from high school.

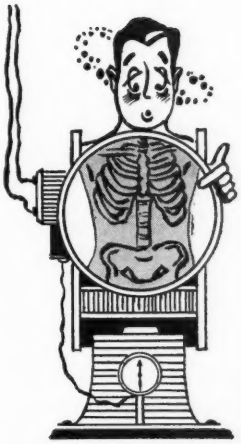
W. P. Y.

(Lube Summarized, from 29)

polar in nature, i.e., mild extreme pressure lubricants. (3) Greases which are polar in nature. In addition to the soap and oil resists being displaced. (4) Lubricants containing solid fillers, such as graphite, talc, mica molybdenum disulfide, etc. These lubricants are normally only used on rough equipment subject to abusive operating conditions, such as bull dozer tracks, etc. (5) The fatty oils, such as lard, castor, rapeseed, etc., are polar in nature and are excellent lubricants for boundary conditions. They are little used because they permit bacteria growth, they oxidize readily to hard varnishes, and they are relatively expensive. They are sometimes compounded with mineral oils to minimize their disadvantages and still retain some advantages.

FLUID FILM LUBRICATION: The oil film thickness is dependent upon the bearing clearance, the viscosity of the lubricant, the surface speed, and the load. There is an optimum clearance. Too small a clearance decreases the thickness of the oil film and load carrying ability as the shaft and the bearing approach parallel motion. Too large a clearance decreases the area of fluid film pressure, thus increasing the unit load with a consequent decrease in the thickness of the oil film. It must not be assumed that we can arbitrarily use a high viscosity lubricant to provide a thick oil film. Viscosity is the friction of a lubricant and as such generates heat. Any mechanism is only capable of dissipating heat at a given rate per degree rise in temperature. We therefore should select a viscosity which will permit of reaching thermal equilibrium below 150 F. If perchance the final viscosity is below 65 SSU we should have a means of cooling to prevent metal to metal contact upon stopping. Although for special applications there has been considerable propaganda concerning high viscosity index oils, those that thin out least with temperature, it is only the remarkable property of petroleum oils to decrease in viscosity with increase in temperature that permits us to operate under widely varying conditions with only a few viscosities.

ROLLING FRICTION: A ball or roller bearing only needs enough lubricant to make up for



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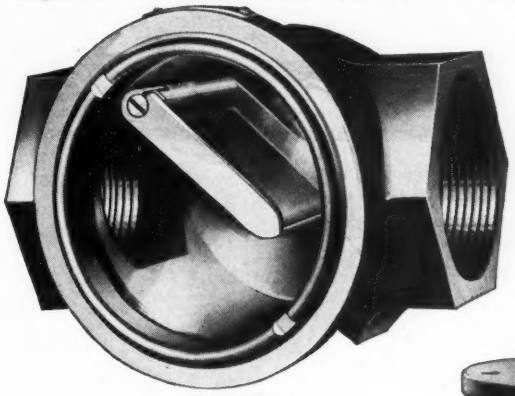

FIG. 811

This vane-type Bowser Indicator is spring-actuated, thus providing an indication of the quantity flowing in the line.

FIG. 811

FIG. 54A

This Bowser Flow Sight is recommended for use on gravity lines where the flow is vertically downward.

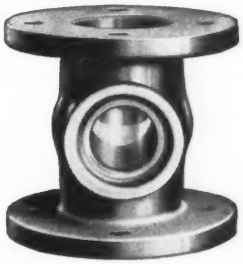

FIG. 54A

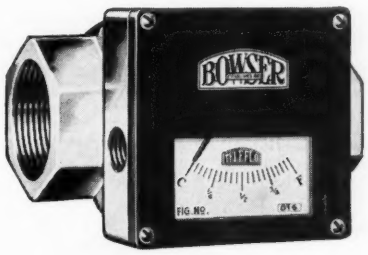

FIG. 816

FIG. 816

The Figure 816 Bowser Teleflo Indicator is equipped to operate a gong or to stop pump motor if liquid flow stops.

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that lost by evaporation or migration. The Hertz equation will show that the load at point of contact of the rollers is far above that which can be supported by an oil film. We therefore only lubricate where there is a differential in speed between the parts. Many bearings are lubricated with grease as it is effective and easily retained in the housing. A grease that adheres to the bearing may be used where speeds are low. A grease that channels should be used for high speeds to prevent excessive working of the grease, and serious temperature rise of the bearing due to the viscosity of the grease. The rule of thumb for oil lubricated bearings is to use the same viscosity of oil for the operating conditions as you would for a sleeve bearing. However in almost all cases the bearings will perform well on all viscous oils. Dirt of any sort is extremely detrimental as it destroys the highly finished surfaces, and failure will be rapid. Any lubricants containing fillers, such as, graphite, talc, mica, etc., should be used with extreme caution. Not only is there a polishing action that wears the bearing, but frequently the filler builds up between the rollers and their spacers actually forcing them apart with consequent bearing failure. Ball and roller bearings are a precision piece of equipment, and failures usually occur because of a neglect of this consideration.

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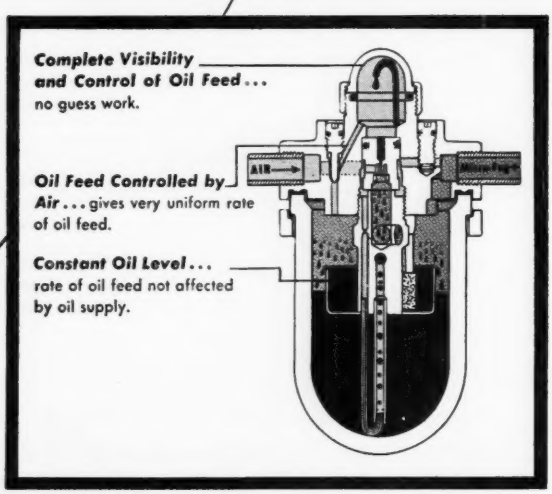
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(Lube in the News, from 31)

of material, even including plastics, glass and ceramics. It is especially effective on porus surfaces, since it fills the pores and provides a feeding-supply of lubricant; the excellence of finish on bearing-parts becomes of less importance, since the MOLY-NAMEL surface, and not the machined surface, carries the load and governs friction. Except in extreme cases, normal clearances need not be disturbed, since the final coating-thickness is no greater than the normal allowances for oil alone. For further information write: The Lockrey Co., Southampton, N. Y., Bulletin 21-H.

ROTARY HAND PUMPS, Bulletin HP206, a new six-page bulletin illustrating Blackmer hand pump sizes from 7 to 28 gallons-per-minute capacity for pumping lube, vegetable or paint oils, syrups, thinners, solvents, cutting and core oils, and industrial liquids from drums, wheel tanks or underground storage, and showing models used as refueling systems for power equipment and mounting accessories for wall, base and pipeline use in plants or as components of manufactured equipment, may be had by writing: Blackmer Pump Co., 1809 Century Ave., SW, Grand Rapids 9, Mich.

THE CASE FOR RE-REFINED OIL, a new 87-page publication presenting facts on ways to cut motor oil costs through the use of the re-refined oil, seeks to inform the reader on the ways in which re-refined oil can not only save money for commercial oil users but can also aid in conservation of a vital natural resource.

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Refiners, 1917 Eye St., NW, Washington 6, D.C.

TRANSMISSION SYSTEMS, Catalog T-50, a new catalog describing completely the pneumatic, magnetic, electric, electronic, and electronic - follower transmission systems for use in measurement and control of flow, pressure, liquid level, viscosity, and specific gravity, and profusely illustrated containing performance characteristics and schematic diagrams of the various systems, may be had by writing: Fischer & Porter Co., 7250 Jacksonville Rd., Hatboro, Pa.

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WIRETEX, a newly developed flexible, high-pressure industrial rubber hose made of mandrel cured, Reprene tube in lengths up to and including 60 feet reinforced with a specially selected textile carcass which is continuously braided around the tube in multiple rubber-impregnated plies, with alternating plies of braided fabrics and braided plies of wire, or with multiple braids of standard or extra heavy wire only, has been designed to carry various types of gases or fluids under both high and low pressures. The hose is not weakened by constant vibration or flexing and will not rust or corrode; built to exceedingly close dimensional tolerances and so constructed that internal pressure surges do not affect the measured flow volumes of the hose, the hose will withstand pressures as high as 5,500 psi. and temperatures from minus 40 F. to plus 200 F. Standard sizes range from 3/16" to 2" for hydraulic control hose. For full details write: Republic Rubber Div., Lee Rubber & Tire Corp., Dept. W., Youngstown 1, Ohio.

(Current Literature, from 33)

CAL PROPERTIES
by G. Weitzel, A. M. Fretzdorff, S. Heller, & E. Graeser, KOLLOID ZEITSCHRIFT, July 1952.

New measuring methods, (some of them refined modifications of older processes, some of them novelties) have been used for measuring monomolecular films of a large number of synthetic substances, most of which have been unknown up till now. The results obtained elucidate the connections between chemical structure and behavior of a substance in a monomolecular film; in particular, the area requirement of branched and unbranched fatty acids. The area required by a molecule in a monomolecular film on water increases, if the chain grows from methyl to butyl.

CAN HEAVY DUTY OILS INCREASE BEARING WEAR?
by Anon., SCIENTIFIC LUBRICATION, Nov. 1952, pp. 22-23, 31.

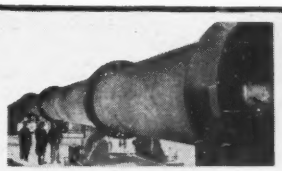
In this article, which is an abstract of a paper written by one of the Ford Motor Co. (U.S.A.) staff, the results of tests on private motor car engines showed increased bearing wear when Heavy Duty oils were used, and especially when used with leaded petrol. Cylinder bore wear was considerably reduced. In spite of this report, as mentioned in May 1952 issue, according to the Chek-Chart, Ford recommended, in the U.S.A., Heavy Duty oils for their cars if subjected to abnormally hard driving conditions. It would seem, therefore, that further tests are needed. Effect of air cleaner efficency is considered. Different methods of oil conditioning were evaluated by tests on fifteen cars.

COLOR OF LUBRICATING OILS
by D. R. Manning, PETROLEUM ENGINEER, Oct. 1952, p. C70.

The Lumetron Colorimeter with accompanying filters has been used as a convenient instrument for determining the ASTM color of lubricating oils and the Saybolt color of waxes. The ASTM procedure for color determination of lubricating oil involves matching the color of a sample of oil with a glass color standard.

DEPARTURE IN LUBRICANT FILTRATION, A
by Anon., OIL ENGINE & GAS TURBINE, Mid-Oct. 1952, pp. 210-211.

A new centrifugal oil filter for vehicle engines and other high-speed units (tested by Albion Motors, Ltd., Glasgow, on one of their 4-cylinder oil engines for 2 yrs.) is on the market. This new filter is essentially a by-pass type and is mounted on the engine so that cleaned



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★ Filtering hydraulic oil eliminates sticking and clogging of valves and reduces down time and maintenance cost. A prominent authority on hydraulic machinery says that 70% of servicing and repairs is due to the improper condition of hydraulic oil.

★ Filtering coolant fluid removes all fine metal particles and grit from grinding wheels that is pumped back to nozzles unless a filter is employed in cleaning up the return coolant.

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REPRESENTATIVES IN PRINCIPAL CITIES

oil drains back into the sump. The oil flow rate through the Model GF1 is such that the sump contents are filtered every few minutes. Purification being achieved by an accelerated gravity settling force, there is no chemical action to affect oil additives. The filter requires no mechanical or electrical drive because the oil itself, when passing through the filter, drives the rotor. Further, there are no elements to replace. Construction is discussed in detail.

DEVELOPMENT OF WAX-TYPE CUTTING OIL
by Anon., INDUSTRIAL LABORATORIES, Oct. 1952, p. 101.

S. C. Johnson & Sons, Inc., Racine, Wis., working with the Engineering Research Institute of the University of Michigan, have developed "Wax-Cut," a machining lubricant reported to have significant advantages for use with automatic screw machines, gear cutting machines, lathes, broaches, and other tools which use oil-type cutting fluids. Excellent lubricating qualities and cooler cutting action, contributing to increased feeds and speeds, better finish, longer tool life, are claimed for the wax-type oil. In University of Michigan tests, which covered a range of 100 different fluids during the project, required cutting forces were reduced as much as 36 per cent, feeding forces as much as 15; while heat reduction minimized smoking and loss of lubricant.

GRAPHITE STRENGTH TESTS AS A BASIS FOR THE CALCULATION OF PRESSURE APPARATUS
by R. Soehngen, CHEMIE INGENIEUR TECHNIK, Sept. 1952, pp. 485-492.

Good experiences made with most of the low-pressure apparatus made of impregnated graphite would let it appear desirable to use this material also for high pressure operations. A team of producer- and user-companies (Siemens Plania—Chemische Fabrik Greisheim—Farben-fabrik Bayer) entertained a joint research project to study the strength of graphite apparatus at the temperature of −50, +20 and +150 C., whereas up till now measurements of impregnated and unimpregnated graphite materials had been made only at room temperature. Tensile strength, compression strength, flexural strength, impact bending strength have been investigated. The results are encouraging.

HOW TO SAVE TIME ANALYZING LUBE OILS FOR METAL ADDITIVES
by H. D. Veldhuis, S. Cohen, & G. A. Nahstoll, PETROLEUM PROCESSING, Sept. 1952, pp. 1311-1313.

A time-saving and accurate spectrochemical method for determining metallic additives in new lube oils and metallic additive and wear elements in used oils has been developed by the Quality Laboratory, Mfg. Staff, Ford Motor Co.

INFANT OF THE LUBRICATION WORLD COMES OF AGE, AN
by J. C. Hall, OKLAHOMA STATE ENGINEER, Nov. 1952, pp. 16-17, 34, 48.

The advantages of fog and mist lubrication for certain types of bearings are outlined and the system explained, particularly the "Oil-Mist" system developed by Alemite. Increased bearing life and substantial decreases in oil consumption are claimed, as well as lower bearing temperatures.

LIST OF PERIODICALS ABSTRACTED
by Anon., CHEMICAL & ENGINEERING NEWS, Nov. 3, 1952, p. 4649.

A new edition of the List of Periodicals Abstracted by Chemical Abstracts has been completed and distributed to subscribers as a part of the subject index of Chemical Abstracts for 1951. It also is available in reprint form from the Special Publications Department of the Society. The reprint lists more than 5,200 scientific journals. Through the co-operation of 280 libraries, journals are keyed to show the locations where files of each are maintained.

MECHANISM OF ACTION OF EXTREME-PRESSURE LUBRICANTS
by C. G. Williams, CHEMICAL ABSTRACTS, Sept. 25, 1952, p. 8840.

Under progressively increasing load the oil film between sliding metals eventually becomes discontinuous and metallic contact begins to occur. The loading practicable without serious surface damage can be increased many fold by using a lubricant containing an additive capable of reacting chemically with sliding surfaces to provide emergency protection. The reaction is accelerated by the sharply rising temperature associated with incipient seizure, and the protective product is formed in just those places where temperatures and pressures rise to values which are extreme relative to those typical of hydrodynamic lubrication. The uses of chlorinated hydrocarbon, metal chlorides, and metal sulfides are discussed.

MODERN MACHINE-TOOL LUBRICATION PRACTICE
by W. D. Whalen, MECHANICAL ENGINEERING, Oct. 1952, pp. 803-809.

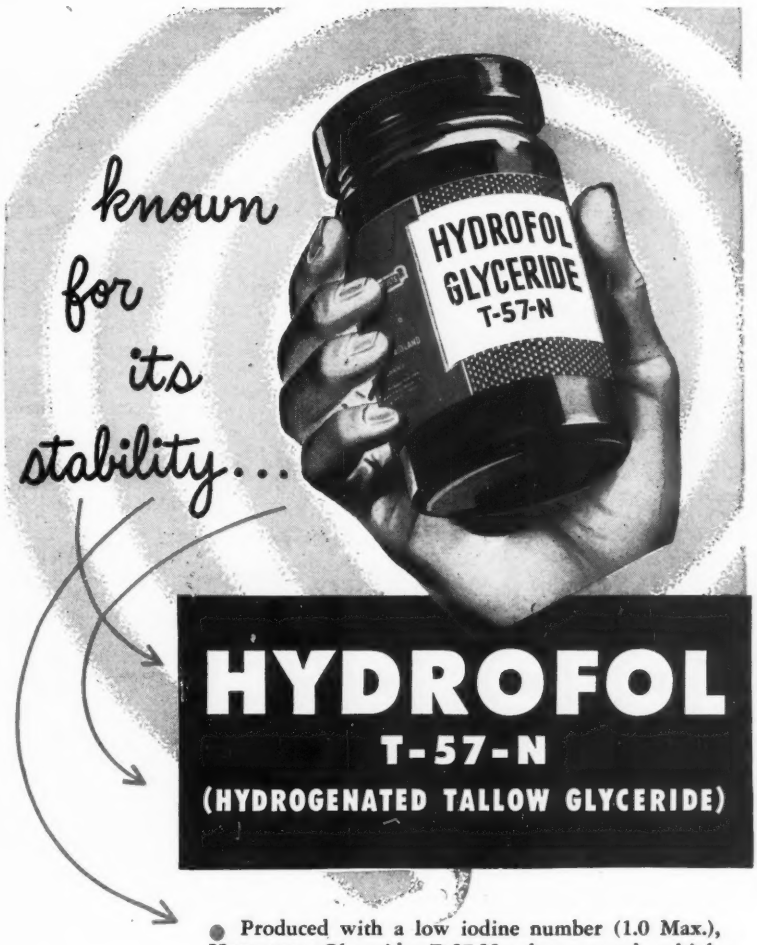
The lubrication of lathes, automatic screw machines, planers, grinders, and special-purpose machines is described. Lubricant recommendations are given.

MOLECULAR STRUCTURE & PROPERTIES OF LUBRICATING OIL COMPONENTS
by J. G. Lillard, W. C. Jones, & J. A. Anderson, INDUSTRIAL & ENGINEERING CHEMISTRY, Nov. 1952, pp. 2623-2631.

In the present work, part of a long-range program, several wax-free lube oil samples covering a wide boiling range and derived from different crudes have been separated into concentrates of various compound types of silica gel percolation. Narrow fractions of the percolates were characterized by measurements utilizing refractive index, carbon-hydrogen ratio, viscosity, and ultraviolet and infrared spectra. These data indicate the lubes to be composed primarily of paraffin-naphthenes, condensed naphthenes, aromatic naphthenes, naphthalenes, and higher aromatics.

NEW-TYPE MOTOR OIL
by G. Weber, OIL & GAS JOURNAL, Nov. 10, 1952, p. 74.

Standard Oil Development Co. has announced a new high-viscosity-index motor oil designed especially for use in high-compression engines operating with close tolerances. The oil has a viscosity-index of 150-155 and will carry the S.A.E. viscosity classification 20-5W. It will meet the requirements of four viscosity classifications: S.A.E. 5W, 10W, 20W, and 20, and will be designated for Service MS and DG. The properties of the oil derive from a combination of im-



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proved additives, which include detergents, oxidation inhibitors, and viscosity-index improvers, and from better petroleum-base stocks produced from selected crudes by improved techniques in solvent extraction and other conventional refining methods.

ROAD & LABORATORY WEAR TESTS OF GEAR OILS
by H. L. Bingham & J. G. Withers, JOURNAL OF THE INSTITUTE OF PETROLEUM, Sept. 1952, pp. 718-728.

The importance of wear in the assessment of automotive gear lubricants is brought out in the full-scale axle tests of the U. S. Army Specifications MIL-L-2105 for hypoid oils. However, in the development of additives and finished lubricating oils, and for routine quality control, it is desirable to have a much less expensive test procedure by which the relative wear characteristics of oils may be judged. Before such a test can be developed it is essential that there should be a background of information on service behaviour, preferably from road tests carried out under ordinary driving conditions. Published data are very limited, and for this reason the present programme has included the compilation of wear data from the back axles of vehicles operating on the road. Four-ball EP lubricant testing machine is illustrated.

ROLE OF CORROSION IN ENGINE WEAR
by J. C. Geniesse & H. R. Jackson, PETROLEUM PROCESSING, Nov. 1952, pp. 1620-1622.

The work of various investigators is reviewed to show the influence of low temperature operation conditions and sulfur content of fuels on wear of cylinder walls and piston rings. Jacket temperature, oil, cylinder wall metallurgy and fuels are important variables in the corrosive wear of engines, and the resulting high oil consumption. Engine wear from this cause can be reduced through proper selection of oil and control of jacket temperature.

ROLLER BEARING GREASE LUBRICANTS FOR RAILWAY CAR JOURNALS
by H. T. Rockwell, INSTITUTE SPOKESMAN, Oct. 1952, p. 10.

The search for a roller bearing grease for railway journals is discussed. The need is for a single grade which will not congeal at low temperatures yet will not become so fluid as to leak out at high temperatures, and which will provide protection against corrosion and wear without undue deterioration, for periods of one to three years, or mileages of 350,000 to 600,000.

SPECIALIZED RESEARCH CONCERNING LUBRICANTS
by Anon., OIL ENGINE & GAS TURBINE, Mid-Sept. 1952, pp. 158-160.

It is said that all oils deteriorate in service, and that the characteristics of such deterioration are as much results of engine design, operating conditions, fuel used and maintenance, as of the lubricant. Thus, if test results are to be of any value they must be obtained not only in a laboratory, but finally under actual service conditions. At C. C. Wakefield & Co., Ltd., lubricating oils were tested on a large scale in engines designed for that purpose. Test engines include a single-cylinder Caterpillar Diesel, a six-cylinder Chevrolet petrol

unit and nine Lauson single-cylinder prime movers with six more in reserve. In addition to the anti-oxidation additives, Wakefield's H.D. oil contains both detergent and dispersant promoters.

(Section News, from 35)

inar on industrial lubrication engineering will be sponsored by the Philadelphia Section. Scheduled to start Tuesday evening, February 10, at Philadelphia's Bellevue-Stratford Hotel, the education course will continue for four more consecutive Tuesdays, ending on March 10th.

The seminar will include detailed explanations and instructions on such subjects as lubricant dispensing equipment, planning and installing complete lubrication maintenance programs, theory and application of drawing compounds and cutting oils, and other allied subjects. Instructors for the course will be industrial lubrication engineers and specialists with long practical experience. The closing meeting will feature a panel discussion in which experts will answer any unusual lubrication application problems. Certificates of attendance and bound copies of instruction data will be presented to those attending the seminar.

To partially defray expenses of this practical course, a nominal fee will be charged for registration, although most of the costs will be carried by the section. For further information or application forms, contact C. R. Schmitt, E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. (Submitted by J. L. Beatty, Publicity Committee Chairman.)

TWIN CITIES: Nov. meeting—R. O. Bartels, Socony-Vacuum Oil Co., presented a paper entitled Some Financial Consideration In The Storing, Handling And Dispensing Of Industrial Lubricants, which illustrated the ways in which money can be lost or saved in the handling of lubricants. Submitted by W. H. Furst, Secy.)

(Patent Abstracts, from 32)

of itaconic acid, said diester having been obtained by esterifying itaconic acid with a primary, normal, aliphatic alcohol having from 1 to 18 carbon atoms, and a metal salt of said copolymer.

GREASE PREPARATION, Patent #2,616,850
by G. V. Browning, assignor to Standard Oil Co.

The method of preparing a grease comprising extracting a grease, comprising a normally liquid organic lubricant and a soap of the high molecular weight carboxylic acid, with a solvent to remove said liquid organic lubricant from said grease, adding a second normally liquid organic lubricant soluble in said solvent to the solvent-soap system and evaporating said solvent.

MINERAL OIL COMPOSITION CONTAINING ESTERS OF PRODUCT OBTAINED BY REACTION BETWEEN MALEIC ANHYDRIDE AND VINYL ACETATE, Patent #2,616,851
by J. J. Giammaria, assignor to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing from about 0.01% to about 10% by weight of a reaction product formed by reacting vinyl acetate with an alpha, beta-unsaturated dicarboxylic acid anhydride, and esterifying the product of this reaction with a normal, saturated, aliphatic alcohol containing from about 12 to about 18 carbon atoms.

MINERAL OIL COMPOSITION, Patent #2,616,852
by J. J. Giammaria, assignor to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing from about 0.01% to about 20% by weight of a reaction product formed by reacting an allyl ester with an alpha, beta-unsaturated material selected from the group consisting of alpha, beta-unsaturated dicarboxylic acids and their anhydrides, and esterifying the product of this reaction with a normal aliphatic alcohol containing from about 8 to about 18 carbon atoms.

MINERAL OIL COMPOSITION CONTAINING ALCOHOL AND AMINE DERIVATIVES OF MALEIC ANHYDRIDE-ITACONIC ACID ESTER COPOLYMERS AS POUR POINT DEPRESSANTS AND VISCOSITY INDEX IMPROVERS, Patent #2,616,853
by J. J. Giammaria, assignor to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing from about 0.01% to about 50% of a product produced by (1) copolymerizing maleic anhydride with a diester of itaconic acid, said diester having been obtained by esterifying itaconic acid with a primary, normal, monohydric, saturated, aliphatic alcohol, to form a copolymer and then (2) reacting said copolymer with a compound selected from the group consisting of a primary, normal, monohydric, saturated, aliphatic alcohol and an amine selected from primary and secondary amines.

PREPARATION OF OLEFIN LUBRICANT HAVING A HIGH VISCOSITY, Patent #2,616,916
by R. L. Heinrich, assignor, by mesne assignments, to Standard Oil Development Co.

A method for increasing the viscosity of an olefinic lubricating oil polymer having lubricating oil characteristics which comprises oxidizing the polymer at a temperature in the range from 300 to 600 F. in the presence of a promotional amount no less than 0.1% by weight of diphenylthiourea to form an oxidized product having an increased viscosity and a low neutralization value and recovering said product.

OIL BASE DRILLING FLUIDS, Patent #2,617,767

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Dr. H. E. Mahncke

by P. W. Fischer, assignor to Union Oil Co. of California

An oil-base drilling fluid essentially comprising a mineral oil having dispersed therein between about 1 and about 10% by weight of an oil-dispersible metal soap, between about 0.1 and about 5% by weight of a hydratable clay, between about 0.2 and about 10% by weight of water, and between about 2 and about 20% by weight of finely-divided substantially petroleum hydrocarbon insoluble pine wood resin.

LUBRICATING COMPOSITIONS, Patent #2,617,768

by W. Pohl, assignor to Shell Development Co.

A marine engine lubricant capable of forming a stable emulsion when in contact with an aqueous medium, containing from 2% to 5% of blown semi-drying fatty oil and from 0.1% to 5% of basic alkaline earth metal salt of oil-soluble petroleum sulfonic acid and the balance being a mineral oil.

ROLLING OIL COMPOSITION, Patent #2,617,769

by C. W. Nichols, Jr., E. L. Armstrong, & H. J. Schroeder, assignors to Socony-Vacuum Oil Co., Inc.

A soluble-oil base consisting of an oleaginous lubricant as a major constituent, a minor proportion, from about 0.1 weight per cent to about 3.0 weight per cent, of water and an amount, from about 0.5 weight per cent to about 15.0 weight per cent, of a non-ionic emulsifier effective to provide a stable emulsion.

OXIDATION RESISTING HYDROCARBON PRODUCTS, Patent #2,618,597

by J. G. McNab, N. V. Hakala, & J. P. McDermott, assignors to Standard Oil Development Co.

A composition consisting essentially of a hydrocarbon oil containing 0.02 to 3% of cuprous di-(methylcyclohexyl) dithiophosphate.

HIGH-TEMPERATURE LUBRICATING GREASE, Patent #2,618,598

by A. J. Morway & P. V. Smith, Jr., assignors to Standard Oil Development Co.

A lubricating grease composition comprising a lubricating oil thickened to a grease consistency with a salt-soap complex which comprises the reaction product of 0.1 to 10% by weight based on the total composition of a metal base with a low molecular weight acid of formula R_1SR_2COOH, wherein R_1 and R_2 are each aliphatic hydrocarbon groups of 1 to 2 carbon atoms, said thickener comprising also 5 to 35% by weight, based on the total composition of a soap of a long chain fatty acid having between 12 and 24 carbon atoms.

HIGH MELTING POINT CALCIUM GREASE OF LOW SOAP CONTENT, Patent #2,618,599

by L. F. King & W. C. Pattenden, assignors to Standard Oil Development Co.

A lubricating grease composition comprising 70 to 95% by weight of a lubricating oil thickened to a grease consistency with 1 to 10% by weight, based on the total composition, of calcium soap of substantially saturated fatty material of the C_{12} to C_{22} range, 1 to 10% of calcium soap of partially dehydrated castor oil, and 1 to 10% of the calcium salt of an aliphatic hydroxy

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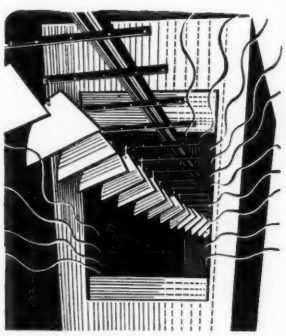
Bearings working at 375°F. in an oven conveyor system for baking the finish on electrical parts, failed frequently in spite of weekly relubrication. And many finished parts had to be rejected because of flaws caused by oil bleeding out of the bearings and dripping onto the uncured paint. Since using Dow Corning 41 Grease, bearing failure and rejects caused by melting grease have been eliminated, and the bearings have to be relubricated only twice a year.

After more than 30 months of service, conveyor bearings lubricated with Dow Corning 41 Grease are still running smoothly through an enamel drying oven operating at 300°F.

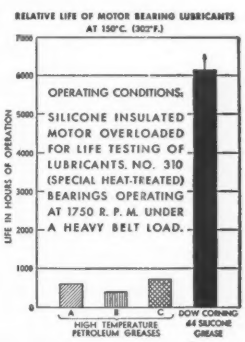


Bearing failures have been eliminated, maintenance and lubrication costs have been reduced to the vanishing point; production has been increased by at least the $100 worth of parts a day that were formerly rejected because the finish was spoiled by the dried-up, graphite-kerosene lubricant that fell down from the bearings.

As an antiseize agent on the die threads of glass forming machines, Dow Corning 41 Grease makes it easy to take dies apart even after 6 months of operation at 340-380°F. Similarly, die assemblies used in molding phenolic closures formerly froze so tight that a welding torch was used to cut the dies and bolts apart. The same assemblies lubricated with Dow Corning 41 are easy to disassemble after long exposure to heat and steam. Hold-down bolts on rubber and plastic presses are also lubricated with Dow Corning 41 to prevent seizure.

DOW CORNING GREASE 44

Count the number of conventional motors you have in your plant. Multiply that number by $4.52 and you have the average yearly cost of lubricating these motors plus the cost of motor failure caused by improper lubrication. With an estimated 10 to 15 million motors now in service, American industry spends 45 to 67 million dollars a year that might be saved by the use of Dow Corning Silicone Grease 44. That possibility is based on the performance of this Dow Corning Silicone grease in about half a million cartridge ball bearings used in a widely advertised line of industrial motors. Experience has proved that these bearings, prelubricated for life with Dow Corning 44, require no further attention.



Annealing Ovens at 1400°F are located only 2 feet from bearings on motor directly coupled to forced draft fans. In spite of frequent relubrication with organic greases these bearings had a service life of about 6 months. The electrical foreman finally installed bearings prelubricated with Dow Corning Grease 44. These bearings have never been relubricated and they are still in service after about 2 years of operation.

Such performance confirms the testing done by Dow Corning, by bearing manufacturers and by the military establishment. It indicates that you can expect Dow Corning Silicone Grease 44 to last at least 10 times longer than high temperature petroleum grease.

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carboxylic acid having not more than 6 carbon atoms per molecule.

SILICONE OIL LUBRICATING COMPOSITION, Patent #2,618,600
by D. H. Moreton, assignor to Douglas Aircraft Co., Inc.
The normally liquid homogeneous silicone oil lubricating composition having improved lubricating and fire-resistance properties consisting essentially of liquid dimethyl silicone polymers, mono-alkyl diaryl phosphate in which the aryl groups are members of the group consisting of phenyl, cresyl and xylyl and the alkyl group has from 4 to 10 carbon atoms, and tri-alkyl phosphate in which the alkyl groups have from 4 to 10 carbon atoms, said silicone polymers having many desirable lubricating properties but being deficient in extreme pressure and load-carrying lubricating properties and incompatible with said mono-alkyl diaryl phosphate without said tri-alkyl phosphate, said mono-alkyl diaryl phosphate being present in a proportion sufficient to improve said lubricating properties and fire-resistance of said composition and being incompatible with said silicone polymers without said tri-alkyl phosphate, and said trialkyl phosphate being present in sufficient proportion to render said silicone polymers and said mono-alkyl diaryl phosphate compatible in the composition.

LUBRICANT CONTAINING A DIMETHYL SILICONE POLYMER AND A TRIALKYL PHOSPHATE, Patent #2,618,601
by D. H. Moreton, assignor to Douglas Aircraft Co., Inc.
The composition consisting essentially of a petroleum hydrocarbon lubricating oil, normally liquid dimethyl silicone polymer of lubricating viscosity and having both the properties of change of viscosity with temperature and pour point lower than those of said petroleum lubricating oil, but immiscible in said petroleum lubricating oil, the proportion of said normally liquid dimethyl silicone polymer being sufficient to lower the change of viscosity with temperature and pour point of the composition below that of said petroleum lubricating oil, and a sufficient proportion of a trialkyl phosphate to make said dimethyl silicone polymer soluble in the composition.

LUBRICATING COMPOSITION OF LOW POUR POINT, Patent #2,618,602
by J. H. Bartlett, assignor to Standard Oil Development Co.
A composition comprising a major proportion of an oil base stock and a minor proportion of polymerized di-alkyl fumaroid acid ester of a saturated aliphatic alcohol of 12 to 14 carbon atoms, said polymer having a molecular weight between 1000 and 30,000.

COMPOSITIONS EMBODYING SOLID LUBRICANTS, Patent #2,619,458
by B. V. McBride, assignor to Westinghouse Electric Corp.
A dry solid lubricant composition comprising as its essential ingredients 100 parts by weight of a solid lubricant selected from at least one of the group consisting of the disulfides, selenides and tellurides of molybdenum, tungsten and titanium, and from 0.2 to 25 parts by weight of a hexavalent chromium compound as a corrosion inhibitor, the lubricant composition functioning in a dry state without corrosion of the bearing surfaces to which it is applied.

LUBRICATING OIL COMPOSITION, Patent #2,619,459
by L. L. Neff, assignor to Union Oil Co. of California
A lubricating oil additive adapted to be diluted with mineral lubricating oil to produce a lubricating oil having detergent and anti-corrosion characteristics, said additive comprising a solution of mineral lubricating oil and an oil-soluble metal salt of the acidic reaction product obtained by condensing, in mineral lubricating oil solution, a mixture of petroleum sulfonic acids and a hydrocarbon substituted phenol having at least 1 hydrocarbon substituent of at least 3 carbon atoms, in which the ratio of mols of sulfonic acids to mols of phenol is between about 0.05 and 3 to 1, and which solution contains a volume of oil at least equal to the volume of sulfonic acids present, with between about 1.25 and 2 equivalents of a low molecular weight aldehyde containing from 1 to 5 carbon atoms per molecule, said condensing being effected by heating to a temperature between 150 F. and 300 F.

LUBRICATING OIL COMPOSITION, Patent #2,619,460
by L. L. Neff, assignor to Union Oil Co. of California
A composition of matter suitable for addition to mineral lubricating oil to impart detergent and anti-corrosion properties to said oil of a complex produced by heating a mixture of 1 mol of phenol, between 0.05 and 3 mols of petroleum sulfonic acids and between 1.25 and 2 equivalents of a low molecular weight aldehyde having 1 to 5 carbon atoms to a temperature between 150 F. and 300 F., thereby producing an oil-soluble acidic condensation product, converting said acidic condensation product into its metal salt and heating a mixture of said metal salt, water and a basically reacting metal compound of the class consisting of metal oxides, metal hydroxides and metal salts of weak acids having an ionization constant less than about $1 \times 10_1$, said last-named metal salts having a basic reaction as indicated by chemical indicators, to a temperature between 150 F. and 500 F. for a time sufficient to solubilize said basically reacting metal compound, the ratio of equivalents of basically reacting metal compound to equivalents of metal salt of said acidic condensation product being between 0.1 and 4 to 1.

LUBRICATING GREASE, Patent #2,619,461
by G. F. Ford, assignor to Phillips Petroleum Co.
A method for producing a grease comprising mixing a fat with a quantity of oil, saponifying the fat of said mixture with a caustic alkali in the presence of said oil, heating the saponified mixture to a temperature from 200 to 250 F., admixing with said saponified mixture an additional quantity of oil, stirring the admixture to produce a fiber structure therein, to the stirred fibrous admixture incorporating with stirring a quantity of gel grease at a temperature between the limits of 60 to 170 F. and the quantity of gel grease incorporated comprises 5 to 95% of the final grease.

MINERAL OIL COMPOSITIONS, Patent #2,619,462.
by L. E. Beare, M. P. Kleinholz, & W. S. Hoock, assignors to Sinclair Refining Co.

A lubricating oil composition comprising predominantly a mineral oil and containing minor but effective proportions for extreme pressure properties of an oil-soluble stable chlorinated hydrocarbon containing about 35 to 75% chlorine and a composition of matter prepared by the reaction at a temperature of about 200 F. to about 400 F. of a bicyclic terpene, sulfur, a phosphorus sulfide, and a compound selected from the class consisting of monohydride lower alkyl phenols and alcohols in which the proportions of terpene to sulfur to phosphorous sulfide to phenol or alcohol are in the approximate molar ratio 3-5:0, 5-5:10, 25-2.

EXTREME PRESSURE LUBRICANT, Patent #2,619,463
by C. Jouandet & J. Reigert, assignors to Esso Standard Societe Anonyme Francaise

A lubricating composition which comprises a major proportion of a mineral lubricating oil and a minor but extreme pressure resistant proportion of a mixture consisting of from 1% to 20% of a chlorinated hydrocarbon, from 0.5% to 5.0% of a phosphorized aryl compound selected from the class consisting of tricresyl phosphate, triphenyl phosphate and trixylyl phosphate and about 1% to about 25% of an oil shale distillation product boiling above about 200 C. and containing high molecular weight alkyl thiophenes, said alkyl thiophenes containing from about 13% to about 25% sulfur, percentages given being by weight based on the weight of the total composition.

LUBRICANT CONTAINING HIGH MOLECULAR WEIGHT ALKYL MONOTHIOCYANATES, Patent #2,619,464
by F. P. Otto, assignor to Socony-Vacuum Oil Co., Inc.

A mineral lubricating oil containing a minor amount, sufficient to reduce the tendency thereof to corrode hard metal alloy bearings, of a paraffin wax monothiocyanate.

STABILIZED HYDROCARBON OILS AND WAXES, Patent #2,619,465
by C. S. Scanley, assignor to Standard Oil Co.

A new composition of matter resistant to oxidative deterioration comprising essentially a hydrocarbon material selected from the group consisting of a hydrocarbon oil, a hydrocarbon wax, and mixtures thereof, normally susceptible to oxidative deterioration, and from about 0.0001% to about 0.0025%, by weight, of 2-methyl-3 phytyl, 1, 4-naphthohydroquinone.

GREASE COMPOSITIONS, Patent #2,620,301
by G. D. McLeod, assignor to Standard Oil Co.

A grease composition comprising essentially a major proportion of a normally liquid oleaginous material, from about 0.1% to about 15% of a water-soluble guanidine salt of a low molecular weight acid, and from about 1% to about 50% of a preferentially oil-soluble hydrocarbon oil sulfonate.

LUBRICATING OIL COMPOSITIONS, Patent #2,620,302
by O. L. Harle, assignor to California Research Corp.

A lubricating oil composition of 1, 2-polyalkylene glycol polymeric material having improved resistance to oxidation, comprising a major proportion of a mixture of 1, 2-polyalkylene glycol polymeric material of lubricating oil viscosity normally susceptible to oxidation and hydrocarbon oil in an amount, by weight, of said polymeric material of about one third to about three-fold the amount of said polymeric material, and, soluble in said mixture, about 0.1% to about 1% of zinc dithiocarbamate and about 1% to about 10% of an alkaline earth metal salt of an alkyl-substituted phenol having at least 4 to 20 carbon atoms in at least one alkyl group.

LUBRICANT, Patent #2,620,304
by W. T. Stewart & A. Goldschmidt, assignors to California Research Corp.

Lubricating oil composition a major proportion of a blend of hydrocarbon oil and polyalkylene glycol polymeric material of lubricating oil vicosity in an amount, by volume, of about one fourth to about four-fold the amount of said hydrocarbon oil, and a minor amount, sufficient substantially to lower the miscibility temperature of said blend, of a solubilizing agent selected from the group consisting of monohydric alcohols and monothiol mercaptans, said solubilizing agent having more than four aliphatic carbon atoms, being free of polar substituents, and being soluble in said blend at the miscibility temperature of said blend.

OIL COMPOSITIONS, Patent #2,620,305
by W. T. Stewart & A. Goldschmidt, assignors to California Research Corp.

Lubricating oil composition comprising a major proportion of a blend of hydrocarbon oil and polyalkylene glycol polymeric material of lubricating oil viscosity in an amount, by volume, of about one fourth to about four-fold the amount of said hydrocarbon oil, and a minor amount, sufficient substantially to lower the miscibility temperature of said blend, of a monoamine having at least five aliphatic carbon atoms, said monoamine being free of polar substituents, and being soluble in said blend at the miscibility temperature of said blend.

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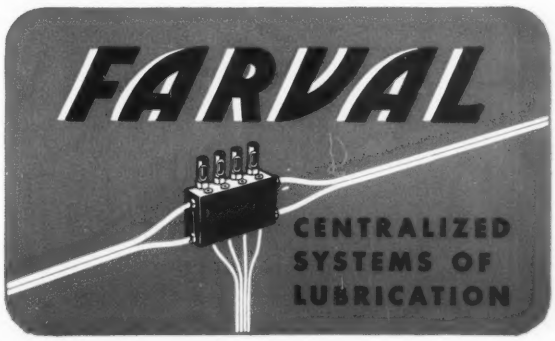

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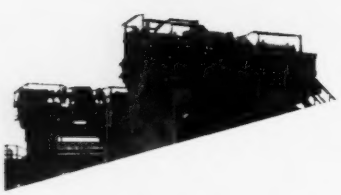

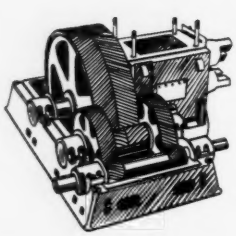

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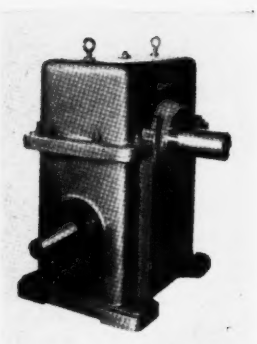

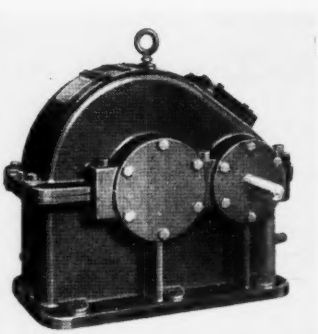

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